10-05-06

Control No.: 09/973,299 PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BOARD OF PATENT APPEALS AND INTERFERENCES

In re Patent of:	Mohamed Khalil et al
Application Number:	09/973,299
Filed:	October 9, 2001
For:	An Improved Assisted Power-Up and Hand-Off System and Method
Group Art Unit:	2616
Examiner:	Nguyen, Phuongchau Ba

Mail Stop Appeal Brief
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

APPEAL BRIEF FILED BY ASSIGNEE APPELLANT
UNDER 37 C.F.R. § 1.192

The Assignee of Record, Nortel Networks Limited., hereby files this Appeal Brief pursuant to 37 C.F.R. §1.192, which appeals the basis of the claim rejections in the Final Office Action mailed on April 4, 2006 by the application Examiner. Appellant, Nortel Networks Limited filed a Notice of Appeal received by the United States Patent and Trademark Office on August 9, 2006. Appellant believes the Examiner's final rejection is

EQ161303935US **EXPRESS MAIL CERTIFICATE**
"Express Mail" mailing label No. _____ Date of Deposit: 10/4/06
I hereby certify that this paper or fee is being deposited in triplicate with the United States Postal Service, "Express Mail" service under 37 C.F.R. 1.10, on the date indicated above and is addressed to Mail Stop Appeal Brief, P.O. Box 1450, Alexandria, VA 22313-1450.

Amy Kasper
Amy Kasper

10/06/2006 AWONDAF1 00000062 09973299
01 FC:1402 500.00 OP

improper because the cited art relied upon by the Examiner fails to disclose, teach or suggest critical claim limitations found explicitly in all the independent claims, and implicitly, in all the remaining claims of the patent. For instance, the cited art relied upon for the Final Rejection fails to disclose, teach or suggest the extended and expanded addressing fields disclosed and claimed in the claimed subject matter, which allows the patented invention to streamline the registration procedures, reduce packet transmission overhead, and improve overall efficiency of the system. For the foregoing reasons, the Examiner's Final Rejection should be reversed.

I. Real Party in Interest (37 C.F.R. §1.192(c)(1))

The real party in interest in this patent application examination is the Assignee of Record, Nortel Networks Limited, as reflected by assignment records at Reel/Frame 012251/0268.

II. Related Appeals and Interferences (37 C.F.R. §1.192(c)(2))

There are no other appeals or interferences relating to the present reexamination application.

III. Status of Claims (37 C.F.R. §1.192(c)(3))

Claims 1-20 are pending in this patent application, and each of those claims stand as finally rejected as noted in the Final Office Action mailed April 4, 2006. *See Exhibit 1, Final Office Action.*

IV. Status of Amendments (37 C.F.R. §1.192(c)(4))

No amendments have been filed or entered after the Final Office Action was mailed on April 4, 2006.

V. Summary of the Claimed Subject Matter (37 C.F.R. §1.192(c)(5))

A. The Problem Addressed By the Claims

When a mobile node moves onto a foreign network, it needs to register with its home agent and be allocated a care-of address to allow for the forwarding of packet transmissions to the mobile node's current location off the home network. In the prior art, the Dynamic Host Configuration Protocol (DHCP) registration process for a mobile node on a foreign network requires numerous hand-shaking messages and responses to adequately register a mobile node with its home agent and assign the appropriate care-of address to the appropriate routers.

The number of required messages and responses is inefficient because these messages increase the overhead transmissions on the system, which inversely decrease the usable bandwidth for data transmissions on the system. This legacy registration system needs to be improved to allow for efficient and effective registration of a mobile node and its care-of address during power-up and hand-off procedures.

B. The Solution Embodied in the Present Application

The invention claimed in the present application (hereinafter also referred to as "the '299 Application") solves the problems in the prior art by using extended and expanded addressing fields disclosed and claimed in the claimed subject matter. *See Exhibit 2, Application, Summary of Invention, p. 9:20-11:20.* The expanded addresses are described in

the '299 Application at page 15, lns. 7-20 and shown in Figure 1A, compared to non-extended addresses described on page 15, ln. 20 to page 16, ln. 22 and shown in Figure 1B. *See Exhibit 2, '299 Application.* The specification of the '299 Application clearly points out that the "new message format shown in Figure 1A offers address fields four times larger than found in the IPv4." *Exhibit 2, The '299 Application, p. 16, ln. 22-24.*

As set forth in the Summary of the Invention of the '299 Application:

> The present invention uses an expanded address format over IPv4, and is intended to reduce the amount of registration control, management messages (e.g. Request and Response messages), and information messages (e.g. Binding Update and Binding Acknowledgement). This invention will increase efficiency of transmission and speed up the mobile IP systems because it reduces the amount of overhead message transmission and routing.

Exh. 2, the '299 Application, Summary, p. 11, ln. 15-20.

The cited art relied upon by the Examiner is simply the legacy DHCP and IPv4 registration system, which does not disclose, teach or suggest critical claim limitations, such as the use of expanded addresses identifying mobile node address, source node address, and destination node addresses. These critical limitations are explicitly set forth in each independent claim, and implicitly, in remaining dependant claims of the patent. The claimed invention uses extended addressing to support an improved registration process, eliminate certain messages and responses, streamline the registration procedures, reduce packet transmission overhead, and improve overall efficiency of the system.

VI. Issues (37 C.F.R. §1.192(c)(6))

A. Whether prior art that fails to disclose, teach or suggest an expanded and extended addressing scheme can be used to invalidate the claimed subject matter under 35 U.S.C. §102, 103 as set forth in the Examiner's Final Office Action.

For the convenience of the Board, the Appellant has provided copies of the Final Office Action at Exhibit 1, the Application at Exhibit 2, the Applicant's January 5, 2006 Response to Office Action at Exhibit 3, U.S. Patent No. 6,892,069 ("Flynn") at Exhibit 4, and a Clean Version of the Claims at Exhibit 5.

VII. Groupings of the Claims (37 C.F.R. §1.192(c)(7))

Because all the claims rely upon the Flynn reference as the entire or partial basis for supporting invalidity, all Claims 1-20 can be grouped into Group 1. Independent Claims 1, 9, and 17 all include the explicit limitations of an expanded address for identifying a network address location for the mobile node, as well as expanded addresses for the source node and the destination node. These claims stand or fall together, and as such, all the claims 1-20 stand or fall based on the Board's analysis of the Flynn reference.

VIII. Argument (37 C.F.R. §1.192(c)(8))

A. Summary of the Rejection

In the Final Office Action in the examination application, the Examiner rejected all claims (Claims 1-20) in the pending U. S. Patent Application No.09/973,299 (hereafter "the '299 Application") under 35 U.S.C. §102, 103 based on the Flynn reference. The text from Flynn relied upon by the Examiner is as follows:

> While the mobile node 6 is on its home network, it has no need for mobility services. When the mobile node 6 is temporarily moved to a foreign network 2, as shown by the dotted box in FIG. 1a, it obtains a temporary care-of address on the foreign network 2. This can be a foreign agent care-of address, which is the IP address of the foreign agent, obtained by receiving or soliciting Agent Advertisements from any foreign agents based on the foreign network 2. Alternatively, the care-of address may be obtained by using an external assignment mechanism, such as Dynamic Host Configuration Protocol (DHCP) (the reader is referred to RFC 1541 for further information), in which case it is known as a co-located care-of address.
>
> The mobile node 6 then registers its new care-of address with its home agent 7 by exchanging Registration Request and Registration Reply messages with it. Registration provides a mechanism by which mobile nodes can communicate their current reachability information to their home agent. The registration process is described in more detail below, assuming that the mobile node 6 on the foreign network 2 is registering a foreign agent care-of address received via an Agent Advertisement from, for example, foreign agent 8.
>
> First, the mobile node 6 sends a Registration Request message to the foreign agent 8, which processes it and forwards it to the mobile node's home agent 7. The Registration Request message includes the IP address of the foreign agent. The home agent 7 sends a Registration Reply message to the foreign agent 8 granting (or denying) the registration request. The foreign agent 8 processes this Reply and forwards it to the mobile node 6. This process establishes a temporary address for the mobile node 6 to which datagrams can be delivered while the node is roaming away from its home network 1.

See Exhibit 4, Flynn, Col. 2, lns. 9-43, Exhibit 1, Final Rejection, Flynn, Col. 2, lns. 9-43 repeatedly cited).

B. The Flynn Reference Does Not Support the Examiner's Invalidity Rejections

The Examiner rejected claims 1-5, 9-14, and 17 under 35 U.S.C. § 102(e) as allegedly anticipated by U.S. Patent 6,892,069 to Flynn (hereafter "Flynn"). The Examiner also rejected dependent claims 6-8, 15-16, and 19-20 under 35 U.S.C. § 103 in view of the combination of several different prior art references with the teachings of the Flynn reference. No explanation was given for the alleged §102 rejection of Claim 20, and no basis

for any rejection of Claim 18 was given in the Final Office Action.

Under 35 U.S.C. §102, the prior art must disclose each and every claim element for an invention to be anticipated by prior art. *Constant v. Advanced Minor–Devices, Inc.*, 848 F. 2d 1560 (Fed. Cir. 1988). All claim limitations of the invention must also be considered in determining patentability. *Hewlett-Packard Co. v. Bausch & Lomb, Inc.*, 909 F. 2d 1464 (Fed. Cir. 1990). Almost is not enough; the prior art must disclose all the elements. *Connell v. Sears, Roebuck & Co.*, 722 F. 2d 1542 (Fed. Cir. 1983). Accordingly, the absence of any claimed element negates anticipation under §102.

The independent claims 1, 9, and 17 were rejected citing Flynn as the primary prior art reference. Claims 1, 9, and 17 possess critical claim limitations describing the information packets containing the expanded network addresses for the mobile nodes, expanded source addresses and expanded destination addresses. These critical expanded addressing claim elements are not taught, disclosed, or suggested by the cited Flynn reference.

The portions of the Flynn reference relied upon by the Examiner simply describe the legacy DHCP registration system. There is no disclosure, teaching or suggestion in the cited portion of the Flynn reference, or in any other reference relied upon by the Examiner, that shows or suggests the expanded and extended addressing scheme described and claimed in the present application. This is a core attribute of the claimed subject matter, and the expanded addressing scheme is one of the primary reasons the claimed invention can achieve efficiencies over the prior art legacy registration system.

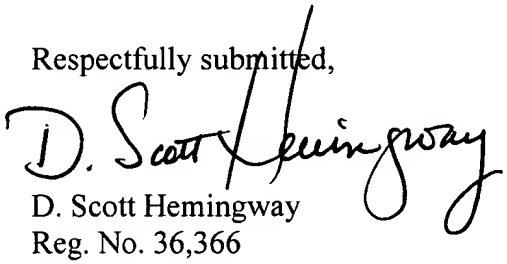
Flynn is the only cited reference for rejecting the independent claims in a § 102(e)

rejection, and Flynn cannot support a § 102(e) rejection of the claims because it fails to disclose, teach, or suggest essential claim elements as identified above. Because the dependent claims add further limitations to the allowable independent claims 1, 9, and 17, the Applicants believe the dependent claims are likewise allowable.

IX. Conclusion

The Appellee respectfully requests reversal of the claim rejections in the examination in light of the remarks. This appeal brief is filed with a fee of $500.00. It is believed that no additional fees are necessary for this filing. If additional fees are required for filing this response, then the appropriate fees should be deducted from D. Scott Hemingway's Deposit Account No. 501,270.

Respectfully submitted,



D. Scott Hemingway
Reg. No. 36,366
Attorney for Appellee and
Assignee of Record

Hemingway & Hansen, LLP
1717 Main Street
Bank One Center – Suite 2500
Dallas, Texas 75201
(214)292-8301 (voice)
(214)739-5209 (fax)

Date: 10-4-2006

VIII. Appendix (37 C.F.R. §1.192(c)(9))

Appendix of Claims
Appendix of Evidence

Exhibit 1	Final Office Action
Exhibit 2	The '299 Application
Exhibit 3	Response to First Office Action
Exhibit 4	'069 Flynn Reference
Exhibit 5	Clean Version of Claims

APPENDIX OF CLAIMS

CLEAN VERSION OF CLAIMS AFTER AMENDMENTS

1. (Amended) A method for registration of a mobile node on a packet-based communication network comprising the steps of:

requesting a care-off address for a mobile node by transmitting a request message to a first node on a first network, said first node capable of assigning a unique care-of addresses to each of a plurality of mobile nodes connecting to said first network;

receiving a care-of address for said mobile node at a home network under a first circumstance from the first network, wherein said care-of address is an expanded address identifying the network address location for said mobile node on the first network, and said care-of address is included in an information packet that comprises a source address data field containing the expanded address for the source node transmitting data in the information packet, a destination address data field containing the expanded address for the intended destination node ultimately receiving the data, and a payload data field containing the data transmitted from the source node to the destination node;

routing a message acknowledging receiving said care-of address to said first network;

allocating a node on the home network to forward information packets to the mobile node at the care-of address using a binding message transmitted on the first network to said node on the home network; and

updating a plurality of nodes with the mobile node registration address on the home network with said care-of address.

2. (Amended) The method of registration of a mobile node on a packet-based communication network of Claim 1, further comprising the step of requesting said care-of address from a serving mobility manager on the first network.

3. (Amended) The method for registration of a mobile node on a packet-based communication network of Claim 2 further comprising the step of allocating said mobile node care-of address on the first network after said request step.

4. (Original) The method for registration of a mobile node on a packet-based communication network of Claim 3 wherein the care-of address is transmitted through the serving mobility manager on the first network to said home network.

5. (Original) The method for registration of a mobile node on a packet-based communication network of Claim 3 wherein the care-of address is obtained from a pool of expanded addresses provided to said serving mobility manager on the first network.

6. (Original) The method for registration of a mobile node on a packet-based communication network of Claim 2 wherein said first network is a foreign

network and said first circumstance is a power-up performed by said mobile node on said foreign network.

7. (Original) The method for registration of a mobile node on a packet-based communication network of Claim 2 wherein said first network is a foreign sub-network located on said home network and said first circumstance is a power-up performed by said mobile node on said foreign sub-network.

8. (Amended) The method for registration of a mobile node on a packet-based communication network of Claim 1 wherein the care-of address is allocated by a server computer on said first network.

9. (Amended) A method of performing a mobile node hand-off on a packet-based communication network, comprising the steps of:

responding at a second network to a request for said mobile hand-off from a first network, said response including allocating a care-of address, said care-of address having an expanded address capable of identifying the network address location for the mobile node on the first network, and said care-of address is included in an information packet that comprises a source address data field containing the expanded address for the source node transmitting data in the information packet, a destination address data field containing the expanded address for the intended destination node ultimately receiving the data, and a

payload data field containing the data transmitted from the source node to the destination node;

transmitting said care-of address from a serving mobility manager on said first network to the mobile node, said serving mobility manager functioning to request said care-of address from a first node on the first network capable of allocating a unique care-of address;

allocating a router on the home network to route information packets to said mobile node at the care-of address using a binding message; and

updating the care-of address for the mobile node on a plurality of nodes on the first network and the home network.

10. (Amended) The method of performing a mobile node hand-off on a packet-based communication network of Claim 9 wherein the first node comprises a computer server.

11. (Original) The method of performing a mobile node hand-off on a packet-based communication network of Claim 9 wherein the first network is a first foreign sub-network on a home network.

12. (Original) The method of performing a mobile node hand-off on a packet-based communication network of Claim 10 wherein the second network is a second foreign sub-network on a home network.

13. (Original) The method of performing a mobile node hand-off on a packet-based communication network of Claim 9 wherein the first network is a first foreign network.

14. (Original) The method of performing a mobile node hand-off on a packet-based communication network of Claim 13 wherein the second network is a second foreign network.

15. (Amended) The method of performing a mobile node hand-off on a packet-based communication network of Claim 9 further comprising the step of moving the mobile node to said second network after requesting said mobile node hand-off.

16. (Amended) The method of performing a mobile node hand-off on a packet-based communication network of Claim 9 further comprising the step of moving the mobile node to said second network before requesting said mobile node hand-off.

17. (Amended) A method of registering a mobile node on a packet-based communication network comprising the steps of:

transmitting a request message from said mobile node to a first router that initiates assigning a care-of address, said mobile node registering on a first network;

receiving a request from said first router at a server computer storing care-of addresses for allocating to registering mobile nodes on the first network;

allocating the care-of address from said server computer, said care-of address having an expanded address for identifying a network address location of said mobile node or other nodes, and said care-of address included in an information packet transmitted over said first network comprising a source address data field containing the expanded address for the source node transmitting data in the information packet, a destination address data field containing the expanded address for the intended destination node ultimately receiving the data, and a payload data field containing the data transmitted from the source node to the destination node;

transmitting said care-of address to a serving mobility manager on a second network, said serving mobility manager allocating a router on the second network to provide routing and other services to the mobile node; and

transmitting said care-of address to said allocated router and responding with a response message to said mobile node indicating registering is complete.

18. (Amended) The method for registering a mobile node on a packet-based communication network of Claim 17 wherein the mobile node moves to the second network after the transmission of the request message.

19. (Amended) The method of registering a mobile node on a packet-based communication network of Claim 17 wherein the mobile node moves to the second network before the transmission of the request message.

20. (Amended) The method for registering a mobile node on a packet-based communication network of Claim 17 wherein the care-of address is transmitted through an AAA server computer on said first network.

APPENDIX OF EVIDENCE

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/973,299	10/09/2001	Mohamed Khalil	P1021 (13574RRUS02U)	6016

7590 04/04/2006

D. Scott Hemingway
Law Offices of D. Scott Hemingway
Preston Commons West, Suite 800
8117 Preston Rd.
Dallas, TX 75225

EXAMINER	
NGUYEN, PHUONGCHAU BA	

ART UNIT	PAPER NUMBER
2616	

DATE MAILED: 04/04/2006

APR 1 1 2006

Final OA due
7/4/06

Please find below and/or attached an Office communication concerning this application or proceeding.

Docketed by AD 4/14/06

EXHIBIT
tabbies
1

PTO-90C (Rev. 10/03)

Office Action Summary	Application No.	Applicant(s)	
	09/973,299	KHALIL ET AL.	
	Examiner	Art Unit	
	Phuongchau Ba Nguyen	2665	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10 January 2006*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *09 October 2001* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless -
>
> (e) the invention was described in a patent granted on an application for patent by another filed in the United States before the invention thereof by the applicant for patent, or on an international application by another who has fulfilled the requirements of paragraphs (1), (2), and (4) of section 371(c) of this title before the invention thereof by the applicant for patent.

The changes made to 35 U.S.C. 102(e) by the American Inventors Protection Act of 1999 (AIPA) and the Intellectual Property and High Technology Technical Amendments Act of 2002 do not apply when the reference is a U.S. patent resulting directly or indirectly from an international application filed before November 29, 2000. Therefore, the prior art date of the reference is determined under 35 U.S.C. 102(e) prior to the amendment by the AIPA (pre-AIPA 35 U.S.C. 102(e)).

2. Claims 1-5, 9-14, 17, 20 are rejected under 35 U.S.C. 102(e) as being anticipated by Flynn (6,892,069).

Regarding claim 1,

Flynn (6,892,069) discloses a method for registration of a mobile node on a packet-based communication network (IP network) comprising the steps of:

requesting a care-of-address for a mobile node by transmitting a request message to a first node on a first network, said first node capable of assigning a unique care-of-addresses to each of a plurality of mobile nodes connecting to said first network {col.2, lines 10-43, wherein the mobile node 6 obtained (requested and got assigned) a temporary care of address from a foreign agent (first node) on the foreign network (first network)};

receiving a care-of address for said mobile node at a home network under a first circumstance from the first network, wherein said care-of address is an expanded address identifying the network address location for said mobile node on the first network, and said care of address is included in an information packet that comprises a source address data field containing the expanded address for the source node transmitting data in the information

packet, a destination address data field containing the expanded address for the intended destination node ultimately receiving the data, and a payload data field containing the data transmitted from the source node to the destination node (col.2, lines 9-43, wherein the home agent received the care of address of the mobile node via a registration request message) ;

routing a message acknowledging receiving said care of address to said first network (col.2, lines 9-43, wherein the home agent acknowledged the receiving of the care of address by sending a registration reply message to the foreign network granting the registration request);

allocating a node on the home network to forward information packets to the mobile node at the care of address using a binding message transmitted on the first network to said node on the home network (col.2, lines 9-43, wherein the home agent would forward data intended for the mobile node 6 using the registered care of address); and

updating a plurality of nodes with the mobile node registration address on the home network with said care-of address (col.2, lines 33-43, wherein the home agent would updating the nodes on the home network with the mobile

node's care of address whenever the node sent a message intended to the mobile node).

Regarding claim 2, Flynn discloses requesting said care-of address (foreign care of address) from a serving mobility manager (Foreign Agent) on the first network (foreign network) (col.2, lines 9-43).

Regarding claim 3, Flynn discloses allocating said mobile node care-of address on the first network (foreign network) after said request step (col.2, lines 9-43).

Regarding claim 4, Flynn discloses wherein the care-of address is transmitted through the serving mobility manager (Foreign Agent) on the first network (Foreign Network) to said home network (col.2, lines 9-43).

Regarding claim 5, Flynn discloses wherein the care-of address is obtained from a pool of expanded addresses (temporary care of address) provided to

said serving mobility manager (foreign agent) on the first network (foreign network) (col.2, lines 9-21).

Regarding claim 9,

Flynn discloses a method of performing a mobile node hand-off on a packet-based communication network, comprising the steps of:

responding at a second network (home network) to a request for said mobile hand-off from a first network (foreign network), said response including allocating a care-of address, said care-of address having an expanded address capable of identifying the network address location for the mobile node on the first network, and said care of address is included in an information packet that comprises a source address data field containing the expanded address for the source node transmitting data in the information packet, a destination address data field containing the expanded address for the intended destination node ultimately receiving the data, and a payload data field containing the data transmitted form the source node to the destination node {col.2, lines 10-43,

wherein the mobile node 6 obtained (requested and got assigned) a temporary care of address from the foreign network (first network)};

transmitting said care of address from a serving mobility manager (an external assignment mechanism DHCP, col.2, lines 17-19) on said first network (foreign network) to the mobile node, said serving mobility manager functioning to request said care of address from a first node (foreign agent or the router connected to the foreign network 8, col.2, lines 2-3) on the first network capable of allocating a unique care of address (col.2, lines 9-43);

allocating a router (home agent, col.2, line 2) on the home network to route information packets to said mobile node at the care of address using a binding message (col.2, lines 48-53, wherein encapsulating the datagrams to form the binding message with the care of address for the mobile node); and

updating the care-of address for the mobile node on the first network (foreign network) and the home network {col.2, lines 33-43, mobile node updating its care of address with the foreign network by registered with the foreign network for a temporary foreign care of address, and updating its

current address (temporary foreign care of address) with the home network by sending a registration request to the home agent}.

Regarding claim 10, Flynn discloses wherein the first node comprises a computer server (inherent database at the router/foreign agent for storing mobility binding of the care of addresses at foreign agent-not shown) (col.9, lines 2-3, 9-43).

Regarding claims 11-14, Flynn discloses foreign care of address allocated from a foreign agent in the roaming/foreign/current network to a mobile node in home network that is other than its home network for roaming, emphasis added (col.2, lines 9-43).

Regarding claim 17,

Flynn discloses a method of registering a mobile node on a packet-based communication network comprising the steps of:

transmitting a request message from said mobile node to a first router (foreign agent) that initiates assigning a care of address, said mobile node registering on a first network (foreign network) (col.2, lines 9-43, mobile node 6 obtained a temporary care of address on the foreign network);

receiving a request from said first router (foreign agent) at a server computer (inherent database at router/foreign agent-not shown) storing care of addresses for allocating to registering mobile nodes on the first network (foreign network)(col.2, lines 9-43);

allocating the care-of address from said server computer (foreign agent), said care-of address having an expanded address for identifying a network address location of said mobile node or other nodes, and said care of address location of said care of address included in an information packet transmitted over said first network comprising a source address data field containing the expanded address for the source node transmitting data in the information packet, destination address data field containing the expanded address for the intended destination node ultimately receiving the data, and a payload data field containing the data transmitted from the source node to the destination

node (col.2, lines 9-43, wherein the mobile node had obtained the temporary care of address from the foreign network);

transmitting said care of address to a serving mobility manager (home agent) on a second network (home network), said serving mobility manager allocating a router on the second network to provide routing and other services to the mobile node (col.2, lines 9-43, wherein the home agent would route message intended to the mobile node in the foreign network using the mobile node's registered care of address); and ,

transmitting said care-of address to said allocated router (home agent) and responding with a response message (registration reply) to said mobile node indicating registering is complete (col.2, line 9-43, wherein the home agent sent a registration reply to the foreign agent to grant the updated care of address of the mobile node).

Claim Rejections - 35 USC § 103

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

4. Claims 6-7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Flynn (6,892,069) in view of Magret (6,804,221).

Regarding claim 6, Flynn discloses wherein said first network is a foreign network and all the claimed limitations, except said first circumstance is a power-up performed by said mobile node on said foreign network.

However, in the same field of endeavor, Magret (6,804,221) discloses said first circumstance is a power-up performed by said mobile node on said foreign network (col.2, lines 54-67, col.3, lines 1-7). Therefore, it would have been obvious to an artisan to apply Marget's teaching to Flynn's system with the motivation being to identify foreign agent or obtain a care of address.

Regarding claim 7, Flynn discloses wherein said first network is a foreign sub-network located on said home network and all the claimed limitations, except

said first circumstance is a power-up performed by said mobile node on said foreign network.

However, in the same field of endeavor, Magret (6,804,221) discloses said first circumstance is a power-up performed by said mobile node on said foreign sub-network. (col.2, lines 54-67, col.3, lines 1-7). Therefore, it would have been obvious to an artisan to apply Marget's teaching to Flynn's system with the motivation being to identify foreign agent or obtain a care of address.

5. Claims 8 and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Flynn (6,892,069) in view of Hiller (6,455,922)

Regarding claim 8,

Flynn discloses all the claimed limitations, except a server computer (Foreign server) on said first network (foreign network). However, in the same of endeavor, Hiller (6,455,922) disclose Foreign AAA server 14 (server computer) on the foreign network, see figure 2. Therefore, it would have been obvious to an artisan to apply Hiller's teaching to Flynn's system with the

motivation being to handle potentially overlapping home addresses of mobile nodes.

Regarding claim 20, Flynn discloses all the claimed limitations, except an AAA server computer (Foreign server) on said first network (foreign network). However, in the same of endeavor, Hiller disclose Foreign AAA server 14 on the foreign network, see figure 2. Therefore, it would have been obvious to an artisan to apply Hiller's teaching to Flynn's system with the motivation being to handle potentially overlapping home addresses of mobile nodes.

6. Claims 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Flynn (6,892,069) in view of Lemilainen (6,681,259)

Regarding claim 15,

Flynn discloses all the claimed limitations, except moving the mobile node to said second network after requesting said system hand-off.

However, in the same field of endeavor, Lemilainen (6,681,259) discloses moving the mobile node to said second network after requesting said system

hand-off (col.13, lines 25-42). Therefore, it would have been obvious to an artisan to apply Lemilainen's teaching to Flynn's system with the motivation being to provide the second mobile terminal to transmit using the same IP address of the first mobile terminal without know the data network and address used by the first mobile terminal.

Regarding claim 18, Flynn discloses all the claimed limitations, except wherein the mobile node moves to the second network (foreign network) after the transmission of the registration request.

However, in the same field of endeavor, Lemilainen (6,681,259) discloses wherein the mobile node moves to the second network (foreign network) after the transmission of the registration request (col.13, lines 25-42). Therefore, it would have been obvious to an artisan to apply Lemilainen's teaching to Flynn's system with the motivation being to provide the second mobile terminal to transmit using the same IP address of the first mobile terminal without know the data network and address used by the first mobile terminal.

7. Claims 16, 19 are rejected under 35 U.S.C. 103(a) as being unpatentable over Flynn (6,892,069) in view of Gudat (6,771,609).

Regarding claim 16,

Flynn discloses all the claimed limitations, except moving the mobile node to said second network before requesting said system hand-off.

However, in the same field of endeavor, Gudat (6,771,609) discloses moving the mobile node to said second network before requesting said system hand-off (col.6, lines 22-30). Therefore, it would have been obvious to an artisan to apply Gudat's teaching to Flynn's system with the motivation being to obtain co-located care of address using service DHCP and provide the ability to change the routing of packets destined to any host to be delivered to anywhere in the Internet.

Regarding claim 19, Flynn discloses all the claimed limitations, except wherein the mobile node moves to the second network before the transmission of the registration request.

However, in the same field of endeavor, Gudat (6,771,609) discloses wherein the mobile node moves to the second network before the transmission of the registration request (col.6, lines 22-30). Therefore, it would have been obvious to an artisan to apply Gudat's teaching to Flynn's system with the motivation being to obtain co-located care of address using service DHCP and provide the ability to change the routing of packets destined to any host to be delivered to anywhere in the Internet.

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Lee (6,535,493); La Porta (6,434,134 & 6,654,359) ; Tummala (6,915,345)

9. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL.** See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

10. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Phuongchau Ba Nguyen whose telephone number is 571-272-3148. The examiner can normally be reached on Monday-Friday from 10:00 a.m. to 2:00 p.m..

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Doris To can be reached on 571-272-7629. The fax

phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Phuongchau Ba Nguyen
Examiner
Art Unit 2616

DUC HO
PRIMARY EXAMINER

3-31-06

Notice of References Cited	Application/Control No. 09/973,299	Applicant(s)/Patent Under Reexamination KHALIL ET AL.	
	Examiner Phuongchau Ba Nguyen	Art Unit 2665	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	Classification
*	A	US-6,445,922 B1	09-2002	Hiller et al.	455/433
*	B	US-6,535,493 B1	03-2003	Lee et al.	455/432.2
*	C	US-6,434,134 B1	08-2002	La Porta et al.	370/338
*	D	US-6,654,359 B1	11-2003	La Porta et al.	370/328
*	E	US-6,915,345	07-2005	Tummala et al.	455/432.1
	F	US-			
	G	US-			
	H	US-			
	I	US-			
	J	US-			
	K	US-			
	L	US-			
	M	US-			

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Attorney Docket No. P1021
(13574RRUS02U)

AN IMPROVED ASSISTED POWER-UP AND HAND-OFF SYSTEM AND METHOD

Related Application Data

This application is the utility patent application related to provisional application Serial No. 60/238,899 filed October 10, 2000.

Technical Field of the Invention

A power-up and hand-off communication protocol in a packet-based communication system.

BACKGROUND OF THE INVENTION

Present-day Internet communications represent the synthesis of technical developments begun in the 1960s. During that time period, the Defense Department developed a communication system to support communications between different United States military computer networks, and later a similar system was used to support communications between research computer networks at United States universities.

The Internet

The Internet, like so many other high tech developments, grew from research originally performed by the United States Department of Defense. In the 1960s, Defense Department officials wanted to connect different types of military computer networks. These different computer networks could not communicate with each other because they used different types of operating systems or networking protocols.

While the Defense Department officials wanted a system that would permit communication between these different computer networks, they realized that a centralized interface system would be vulnerable to missile attack and sabotage. To avoid this vulnerability, the Defense Department required that the interface system be decentralized with no vulnerable failure points.

The Defense Department developed an interface protocol for communication between these different network computers. A few years later,

the National Science Foundation (NSF) wanted to connect different types of computer networks located at research institutions across the country. The NSF adopted the Defense Department's interface protocol for communication between the research computer networks. Ultimately, this combination of research computer networks would form the foundation of today's Internet.

Internet Protocols

The Defense Department's interface protocol was called the Internet Protocol (IP) standard. The IP standard now supports communication between computers and networks on the Internet. The IP standard identifies the types of services to be provided to users and specifies the mechanisms needed to support these services. The IP standard also describes the upper and lower system interfaces, defines the services to be provided on these interfaces, and outlines the execution environment for services needed in this system.

A transmission protocol, called the Transmission Control Protocol (TCP), was developed to provide connection-oriented, end-to-end data transmission between packet-switched computer networks. The combination of TCP with IP (TCP/IP) forms a system or suite of protocols for data transfer and communication between computers on the Internet. The TCP/IP standard has become mandatory for use in most packet switching networks that connect or have the potential for utilizing connectivity across networks or sub-network boundaries.

A computer operating on a network is assigned a unique physical address under the TCP/IP protocols. This is called an IP address. The IP address can include: (1) a network ID and number identifying a network, (2) a sub-network IP number identifying a substructure on the network, and (3) a host IP number identifying a particular computer on the sub-network. A header data field in the information packet will include source and destination addresses. The IP addressing scheme imposes a sensible addressing scheme that reflects the internal organization of the network or sub-network.

A router is located on a network and is used to regulate the transmission of information packets into and out of computer networks and sub-networks. A router interprets the logical address of an information packet and directs the information packet to its intended destination. Information packets addressed between computers on the sub-network do not pass through the router to the greater network, and as such, these sub-network information packets will not clutter the transmission lines of the greater network. If data is addressed to a computer outside the sub-network, the router forwards the data onto the greater network.

The TCP/IP network includes protocols that define how routers will determine the transmission path for packets through the network. Routing decisions are based upon information in the IP header and entries in a routing table maintained on the router. A routing table possesses information for a router

to make a determination on whether to accept the communicated information packet on behalf of a destination computer or pass the information packet onto another router.

The routing table can be configured manually with routing table entries or with a dynamic routing protocol. In a dynamic routing protocol, routers update routing information with periodic information packet transmissions to other routers on the network. The dynamic routing protocol accommodates changing network topologies, network architecture, network structure, layout of routers, and interconnection between hosts and routers.

The IP-Based Mobility System

The Internet protocols were originally developed with an assumption that Internet users would be connected to a single, fixed network. With the advent of portable computers and cellular wireless communication systems, the movement of Internet users within a network and across network boundaries has become common. Because of this highly mobile Internet usage, the implicit design assumption of the Internet protocols has been violated.

In an IP-based mobile communication system, the mobile communication device (e.g. cellular phone, pager, computer, etc.) can be called a mobile node. Typically, a mobile node maintains connectivity to its home network through a foreign network. The mobile node will always be associated with its home networks for IP addressing purposes and will have information routed to it by

routers located on the home and foreign networks. The routers can be referred to by a number of names including Home Agent, Home Mobility Manager, Home Location Register, Foreign Agent, Serving Mobility Manager, Visited Location Register, and Visiting Serving Entity.

Authenticate, Authorize, and Accounting

In an IP-based mobile system, the mobile node maintains its connectivity to the home system through a foreign network. While coupled to a foreign network, the mobile node will be assigned a temporary IP address, so information packets addressed to the mobile node can be routed to the temporary IP address for the mobile node on the foreign network.

When a mobile node is operating on a foreign network, specialized servers are used to authenticate, authorize, and collect accounting information for services rendered to the mobile node. This authentication, authorization, and accounting activity is called "AAA," and AAA computer servers on the home and foreign network perform the AAA activities.

Authentication is the process of proving one's claimed identity, and security systems on a mobile IP network will often require authentication of the system user's identity before authorizing a requested activity. The AAA server authenticates the identity of an authorized user and authorizes the mobile node's requested activity. Additionally, the AAA server performs the accounting functions by tracking usage on the network.

Functionally, a mobility manager will communicate with the AAA server in the current domain, allocating another router to route information packets destined for a mobile node while it is located away from its home sub-network. The mobility manager may have access to authentication and key generation AAA functions to authenticate and generate session keys. The mobility manager may also perform agent functions to forward packets to the mobile node until registration is completed.

IP Mobility Protocol

During the formative years since the Internet was first established, Internet Protocol version 4 (IPv4) was recognized and adopted as the standard Internet protocol. With the advent of mobile IP and proliferation of computers and computer systems linked to the Internet, various limitations in the IPv4 standard and associated procedures have developed and emerged. The most pressing limitation in IPv4 is the restriction on number of IP addresses. As shown in Fig. 1B, the address field size in an IPv4 packet is only 32 bits.

A number of benefits emerge from having a larger address field. First, there is little chance of exhausting the number of possible IP addresses. Second, a large address field allows aggregation of many network-prefix routers into a single network-prefix router. Finally, large addresses allow nodes to auto configure using simple mechanisms. More efficient system designs are thus

possible with an expanded address space. Thus, there is a need for an IP standard with a larger IP address space.

In wireless IP networks and sub-networks (divisions of a network), mobile nodes can be physically located anywhere on the network or sub-network. Wireless IP networks handle the mobile nature of mobile nodes with power-up and hand-off procedures designed to inform the mobile node's home network and sub-network of the location of the mobile node for packet routing purposes. Because mobile nodes can move within sub-networks and between networks, hand-off procedures need to be implemented to insure that packets are continually routed to the mobile node as it moves from one network to another or from one sub-network to another.

Current protocols for obtaining a care-of address and procedures for power-up registration and hand-off procedures are insufficient to handle current packet-based communication demands. For example, the prior power-up and hand-off protocols utilize system architecture that was designed to operate within the constraints of IPv4's limited address space. These constraints are insufficient for supporting a standard that needs a larger address space and the associated network design architecture. Therefore, a need exists to establish a new user protocol for power-up and hand-off procedures for mobile IP networks using an expanded address space.

A new protocol for power-up and hand-off is also needed to satisfy the following criteria:

1) Data transfer to a given mobile node should not be hampered by the introduction of additional functional architecture,

2) The new protocol should require only minimal extensions and should exploit and track evolving routing and addressing capabilities,

3) The new protocol should be generic and independent of the type of wireless technology or access medium,

4) The protocol should fully support and be consistent with an AAA architecture,

5) The new protocol should optimize air interface usage for efficiency, reducing the number of required overhand messages, such as Binding Update and Binding Acknowledgement messages, and

6) The protocol should also offer protection against over-use or monopolization of resources by certain mobile nodes.

SUMMARY OF THE INVENTION

The present invention offers new methodologies or protocols for establishing a communication link with a mobile node at power-up and maintaining that link with hand-off procedures on or between networks. The invention uses care-of addressing located in an expanded address field in request

and response messages. The invention also, at times, uses Dynamic Host Configuration Protocol (DHCP) servers and AAA computer servers to facilitate power-up registration and hand-off procedures involving a mobile node. Using the DHCP server streamlines the procedure, reducing packet transmission overhead and improving the efficiency of the system.

The first embodiment of the invention is called Intra-Domain Power-Up Registration. This embodiment specifies registration message flow when a mobile node powers-up in a foreign sub-network located on a home domain, sending registration message through a serving mobility manager (SMM) to a DHCP server.

The second embodiment is for Reactive Intra-Domain Hand-off, and this embodiment is used when the mobile node is performing hand-off from a sub-network to another sub-network within the home network. In this embodiment, the mobile node has no forewarning of the move from one sub-network to another.

The third embodiment is a Proactive Intra-Domain Hand-off. This embodiment is used where the mobile node has knowledge that it will move to a new sub-network, but the mobile node does not yet have a link layer connectivity established with the new sub-network.

The fourth embodiment of the invention is the Inter-Domain Power-Up Registration protocol, which is used when the mobile node powers up on a foreign

domain. In this embodiment, the mobile node registers through the AAA server on the foreign network.

The fifth embodiment of the invention is the Reactive Inter-Domain Hand-off protocol, which is used when the mobile node moves into a new foreign domain. The mobile node in this embodiment must use the AAA server to register on the foreign network.

The sixth embodiment of the invention is the Proactive Inter-Domain Hand-off and covers the situation where the mobile node is aware that it will move to a new sub-network that is part of a foreign network, but the mobile node does not have a link connectivity established with the new foreign sub-network.

The present invention uses an expanded address format over IPv4, and is intended to reduce the amount of registration control, management messages (e.g. Request and Response messages), and information messages (e.g. Binding Update and Binding Acknowledgement). This invention will increase efficiency of transmission and speed up the mobile IP systems because it reduces the amount of overhead message transmission and routing.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects and features of the invention will become more readily understood from the following detailed description and appended claims when

read in conjunction with the accompanying drawings in which like numerals represent elements and in which:

Fig. 1 is a communication network for the Intra-Domain Power-Up Registration embodiment where a mobile node powers-up on a foreign sub-network of its home network;

Fig. 1A is the information packet format used in the present invention;

Fig. 1B is the prior art information packet format;

Fig. 2 is a message flow diagram for registration of the mobile node in the embodiment of Fig. 1 for an Intra-Domain Power-Up Registration;

Fig. 3 is a communication network for the Reactive Intra-Domain Hand-off with a mobile node moving from a sub-network, with no advance notice, to a foreign sub-network;

Fig. 4 is a message flow diagram for the Reactive Intra-Domain Hand-off for a mobile node performing a hand-off in Fig. 2;

Fig 5. is a communication network with a mobile node performing a Proactive Intra-Domain Hand-off moving, with advance notice, from a sub-network to a foreign sub-network on a home network;

Fig. 6 is a message flow diagram for a mobile performing a Reactive Intra-Domain Hand-off in Fig. 5;

Fig. 7 shows a home communication and a foreign communication network with a mobile node powering up on the foreign network in an Inter-Domain Power-Up Registration;

Fig. 8 is a message flow diagram for an Inter-Domain Power-Up Registration of the mobile node on the foreign network in Fig. 7;

Fig. 9 shows a home communication network and two foreign communication networks, with a mobile node moving unexpectedly from one foreign network to another and performing a Reactive Inter-Domain Hand-off;

Fig. 10 is a message flow diagram for the Reactive Intra-Domain Hand-off of the mobile node in Fig. 9;

Fig. 11 shows a home communication network and two foreign communication networks, with a mobile node moving with advance notice from one foreign network to the other and performing a Proactive Inter-Domain Hand-off; and

Fig. 12 is a message flow diagram for the Proactive Inter-Domain Hand-off of the mobile node in Fig. 11.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Figure 1 shows a Mobile Node (MN) 64 powering up on a foreign sub-network 50 of a home network 100. The home network 100 has a central buss line 54 coupled to a home AAA server (HAAA) 20 by communication link 55, a

DHCPv6 server 30 coupled by communication link 56 to the buss line 54, a home mobility manager (HMM) 40 coupled by communication link 17 to the buss line 54, and a serving mobility manager (SMM) 10 coupled by communication link 15 to the buss line 54. The home sub-network 51 of the MN 64 consists of the HMM 40 coupled to the home agent 25 by communication link 19. The foreign sub-network 50 consists of the SMM 10. MN 64 is linked to SMM 10 by a communication link 62, which may be a wired or wireless connection.

In Figure 1, the MN 64 is powering up on a foreign sub-network 50. Figure 2 shows the registration message flow for the situation where the MN 64 powers up on a foreign sub-network within the home network. This embodiment is referred to as an Intra-Domain Power-Up Registration. The MN 64 constructs a local IP address for use on the foreign sub-network 50 by sending a Registration Request message (Reg Req) 105 to the SMM 10. This Reg Req 105 is for allocation of a co-located, globally routable long-term IP address for the MN 64 while it remains on the current sub-network 50. The Reg Req 105 also contains coincidental information to verify the identity of the MN 64. The SMM 10 will validate the identity of the MN 64, and then send a DHCPv6 Request message (DHCPv6 Req) 110 to the DHCPv6 server 30 requesting a new address for MN 64. The DHCPv6 server 30 allocates a new address to use as a care-of address and sends a DHCPv6 Reply message (DHCPv6 Rep) 115 back to the SMM 10 with the new address. The SMM 10 relays this new address to the MN 64 with a

Registration Response message (Reg Res) 120. The format of the IP header in the Registration Response message Reg Res 120 is shown in Figure 1A.

Figure 1A shows the new information packet's IP header format with an expanded address field. The Version (V) field 71 is a 4-bit long data field that is used to designate the IP version number. The Priority (P) field 72 designates the desired delivery priority of the information packet. The Payload Length field (PL) 74 is the length of the rest of the packet following the IP header fields in octets. The Next Header field (NH) 76 identifies the type of header immediately following the IP header fields. The Hop Limit field (HL) 75 is an 8-bit integer value that is decremented by 1 for each node that forwards the packet. The Source Address field (SA) 77 is the 128-bit address of the source node of the information packet. The Destination Address field (DA) 78 is the 128-bit address of the intended destination node. Various message extension types, additional headers, and data fields can be found in the Payload fields (PLD) 79, the Reg Res 120 and Reg Req 105 being two of the possible types. The 128-bit care-of address will be in one of these PLD fields 79 in Reg Res 120.

Figure 1B shows the prior art IPv4 information packet's IP header format. The Version (V) field 81 is a 4-bit long field that is used to designate the IP version number (version 4 in this case). The Internet Header Length field (IHL) 82 is 4-bits long and is the length of the IP header in 32-bit words. The Type of Service (TOS) field 83 is 8-bits long and is an abstract indication of the quality of

service desired. The Total Length (TL) field 84 is 16-bits long and is the length of the information packet in octets.

The Identification field (ID) 85 is 16-bits long and is assigned by the source node to aid in assembling fragments of an information packet at the destination node. The Flag field (F) 86 is a 3-bit field with control bit flags. The Fragment Offset field (FO) 87 is a 13-bit long field that indicates where the information packet belongs in a multiple-packet message. The Time-to-Live (TTL) field 88 is an 8-bit long field that indicates the maximum time the information packet will be allowed to exist in the system before deletion. The time unit indicated is seconds. The Protocol field (P) 89 will indicate the next protocol level used in the Payload portion (PLD) 95 used in the information packet. The header Checksum field (CS) 90 is used to verify the information packet.

The Source Address field (SA) 91 is a 32-bit field identifying the source of the information packet. The Destination Address field (DA) 92 is a 32-bit field identifying the intended destination of the information packet. The Payload fields (PLD) 93 are found after the IP header and include various message extensions, additional headers, and data fields. Compared to the IPv4 address fields, which include possible care-of addresses, the new message format shown in Figure 1A offers address fields four times larger than found in IPv4.

The new address allocated by Reg Res 120 is used by the MN 64 as the care-of address for routing data packet while it remains on the foreign sub-network 50. After receiving the allocated new address, the MN 64 sends a Binding Update (BU) message 125 to the HMM 40 on the home sub-network 51. The HMM 40 may allocate a router, HA 25, to provide routing and other services to the MN 64. If the HMM 40 allocates HA 25, a Binding Update (BU) message 130 is transmitted to HA 25. The allocated HA 25 registers the MN 64 and responds with a Binding Acknowledgement (BA) message 135 to the HMM 40. The HMM 40 will transmit a Binding Acknowledgement (BA) message 140 back to MN 64 confirming receipt of the BU 125 and binding.

Figure 3 depicts the situation where a mobile node moves unexpectedly from one sub-network 281 to another sub-network 280 within a home network 300 and must perform a hand-off routine. The embodiment to handle this situation is referred to as a Reactive Intra-Domain Hand-off. Figure 3 shows a MN 264 linked to a transceiver 260 by a communication link 266. The transceiver 260 is linked to a sub-network 280 on network 300 via new SMM (nSMM) 210 by communication link 259. Although this link to the network 300 is a wireless connection, alternatively the connection could be a wired connection linking the MN 264 to the nSMM 210. The sub-network 280 consists of nSMM 210, and it is a foreign sub-network 280 for the MN 64 on the home network 300. The nSMM 210 is linked to a central buss line 254 by communication link 215.

A home AAA server (HAAA) 220 is coupled to the buss line 254 by communication link 255, and a DHCPv6 server 230 is coupled to buss line 254 by communication link 256. The old SMM (oSMM) 212 is coupled to the buss line 254 by communication link 216. A home agent (HAn) 226 is connected to oSMM 212 by communication link 263. The oSMM 212 and HAn 226 form another foreign sub-network 281 on the home network 300.

A HMM 240 is coupled to the buss line 254 by communication link 217, and a home agent (HAm) 225 is coupled to HMM 240 by communication link 219. The HMM 240 and HAn 225 are the MN 64's home sub-network 282 on the home network 300. The network 300 is linked to the Internet 235 by communication link 271 connected to central buss line 254. A correspondence node (CN) 274 is also linked to the Internet 235 by communication link 272, which may be a wired or wireless link. MN 264' is the prior location of MN 264, which is shifting connection on network 300 as shown.

In Figure 3, the MN 264' is shown connected to the foreign sub-network 281 and is moving unexpectedly from an area covered by oSMM 212 on foreign sub-network 280 to an area covered by nSMM 210 on foreign sub-network 281. Figure 4 shows the message flow for this embodiment where MN 264 is performing hand-off from one foreign sub-network 281 to another foreign sub-network 280 within a home network 300 without prior notice. This new embodiment is referred to as a Reactive Intra-Domain Hand-off.

In Figure 4, the MN 264 constructs a local IP address for use on the foreign sub-network by sending a Reg Req message 305 to the nSMM 210. The Reg Req 305 is for allocation of a globally routable IP address for MN 264 to use on the current sub-network 280. The format of the IP header for Reg Req 305 is the same as shown in Fig. 1A. The MN 264 will also provide coincidental information to verify its identity in the Reg Req 305. The nSMM 210 verifies the identity of the MN 264 and then transmits a DHCPv6 Req 310 to the DHCPv6 server 230 requesting allocation of an IP address. The DHCPv6 server 230 allocates a care-of address and transmits a DHCPv6 Res 315 back to the nSMM 210 with the care-of address. The nSMM 210 then transmits a Reg Res message 320 containing the allocated new address.

After forwarding the Reg Res 320 to the MN 264, the nSMM 210 transmits a System Hand-off and Context Request message (SHC Req) 325 to the oSMM 212. Upon receiving the SHC Req 325, the oSMM 212 will task HAn 226 to forward information packets from the previous care-of address to the new care-of address (e.g. the new address allocated by DHCPv6 server 230). To task HAn 226, the oSMM 210 sends a Binding Update message (BU) 330 to HAn 226 along the same link the previous care-of address is located on. The HAn 226 responds with a Binding Acknowledgement message (BA) 335. The oSMM 212 then sends a System Hand-off and Context Reply (SHC Rep) 340 back to nSMM 210

providing user context data, which is composed of information such as session keys for the type of services granted.

After being assigned a care-of address in the Reg Res 320 and receiving context data, the MN 264 sends a BU 345 to the HMM 240, which includes a list of all IP addresses of all correspondent nodes the MN 264 is communicating with (e.g. CN 274). When the HMM 240 receives the BU 345, it allocates a home agent - HAm 225 - to serve the MN 264, and sends a BU 350 to bind the designated HAm 225. The HAm 225 processes and validates the BU 350. After completing processing of the BU 350, the HAm 225 sends a BA 355 to the HMM 240.

Upon receipt of the BA 355, the HMM 240 sends a BA 360 to the MN 264, and the HMM 240 updates all the correspondence nodes listed by the MN 264 in the BU 345 (e.g. CN 274) with the care-of address. This is accomplished by sending a BU 365 to CN 274 (and any other node), which will reply with a BA 370. After a specified period of time to allow forwarding of all messages, the allocation of HAn 226 expires, because all future messages are forwarded to the care-of address and/or the HAm 225.

Figure 5 depicts a MN 464 linked to a foreign sub-network 481 on its home network 500. The MN 464 is aware it will move to a new foreign sub-network 480, which consist of an nSMM 410, but the MN 464 does not yet have a link layer connectivity established with the new sub-network 480. The home

network 500 consists of a HAAA server 420, a DHCPv6 server 430, nSMM 410, a HMM 440, a HAm 425, an oSMM 412, and a HAn 426.

The MN 464 is connected to a transceiver 460 by wireless link 466. The transceiver 460 is connected to the oSMM 412 by communication link 459. Although this communication link from the MN 464 to the oSMM 416 includes a wireless connection, this link could alternatively be a wired connection linking MN 264 to oSMM 412. The oSMM 412 is coupled to a HAn 426 by communication link 463 and to bus line 454 by communication link 416. Foreign sub-network 481 consists of oSMM 412 and HAn 426.

The DHCPv6 server 430 is connected to buss line 454 by communication link 456. The HAAA 420 is connected to buss line 454 by communication link 455. The HMM 440 is connected to buss line 454 by communication link 417. HMM 440 is also connected to HAm 425 by communication link 419. Home sub-network 482 consists of nHMM 440 and HAm 425. The nSMM 410 is connected to the buss line 454 by communication link 415, and foreign sub-network 480 consists of nSMM 410. The home network 500 is connected to the Internet 435 by communication link 471 to buss line 454. Correspondence node (CN) 474 is connected to the Internet 435 by communication link 472, which may or may not include a wireless link. The MN 464' connected to nSMM 410 is the future location of MN 464.

Figure 6 shows the message flow for the embodiment in Figure 5, referred to as a Proactive Intra-Domain Hand-off. When the MN 464 detects that it will move to new sub-network 480 on the home network 500, it sends a System Hand-off Request message (SHO Req) 505 to the oSMM 412, the current serving mobility manager on sub-network 481. The format of IP header for SHO Req 505 is the same as shown in Fig. 1A. The oSMM 412 transmits a Hand-off and Context Transfer Request message (HCT Req) 510 to the nSMM 410 on the sub-network 480, the future serving mobility manager. The nSMM 410 sends a DHCPv6 Req 515 to the DHCPv6 430 requesting a new address to allocate as a care-of address. The DHCPv6 430 transmits the care-of address to the nSMM 410 in a DHCPv6 Res 520.

The nSMM 410 transmits a Hand-off and Context Transfer Response (HCT Res) 525 allocating a care-of address to the oSMM 412. The oSMM 412 allocates HAn 426 to bi-cast the data destined to MN 464 to both the old and new care-of address. To accomplish this, a BU 530 is transmitted from the oSMM 412 to HAn 426, which will respond with a BA 535 to oSMM 412. The oSMM 412 will then send a System Hand-off Response message (SHO Res) 540 to confirm execution of the hand-off procedures and transmit the allocated care-of address to MN 464.

After the MN 464 receives SHO Res 540 from oSMM 412 and establishes a Layer-2 connectivity with the nSMM 410 on new sub-network 480, it will send

BU 545 to HMM 440 to update the current binding on the home sub-network 482 with the new care-of address. The HMM 440 will update the binding to HAm 425 by sending a BU 550 to HAm 425, which in turn will transmit a BA 555 to the HMM 440. The HMM 440 will transmit a BA 560 to the MN 440 acknowledging the BU 545. The HMM 440 will also update the binding on CN 474 with the care-of address by transmitting a BU 565 to the CN 474, and the CN 474 will acknowledge with a BA 570. If the MN 464 does not receive a SHO Res 540 from oSMM 412 because it has Layer-2 disconnection with the current foreign sub-network 481, the MN 464 will initiate the Reactive Intra-Domain Hand-off protocol.

Figure 7 shows MN 664 powering up on a foreign network 700. The MN 664 is connected to the foreign network 700 by communication link 659. The foreign network 700 includes the FAAA 621, the DHCPv6 631, and the nSMM 610. The communication link 659 can be a wired or wireless connection. Communication link 659 is connected to the nSMM 610. The nSMM 610 is coupled to a buss line 653 by communication link 615. The foreign AAA server (FAAA) 621 is coupled to the buss line 653 by communication link 652, and the DHCPv6 server 631 is coupled to the buss line 653 by communication link 633.

The foreign network 700 is coupled to the Internet 670 by communication link 673, which is coupled to buss line 653. The Internet 670 is coupled to the

home network 699 by communication link 671, which is connected to buss line 654.

The home network 699 includes the HAAA 620, the HMM 640, and the HAm 625. A home AAA (HAAA) server 620 is coupled to buss line 654 by communication link 656. A HMM 640 is connected to buss line 654 by communication link 617, and HMM 640 is connected to HAm 625 by communication link 619.

When the MN 664 powers up on foreign network 700, Figure 8 shows the message flow under the new embodiment. This embodiment is referred to as an Inter-Domain Power Up Registration. The MN 664 sends a Reg Req 705 to the nSMM 610 on the foreign sub-network 700 to obtain a co-located, globally routable address. The format of the IP header for Reg Req 705 is the same as shown in Fig. 1A. The nSMM 610 validates the identity of the MN 664 using coincidental information in the Reg Req 705. After validation, the nSMM 610 transmits a DHCPv6 Req 710 to the DHCPv6 server 631. The DHCPv6 server 631 allocates a co-located IP address to use as a care-of address and sends a DHCPv6 Res 715 back to the nSMM 610 with the new care-of address.

At this point, the nSMM 610 may generate and transmit an optional IP Offer message 720 to the MN 664 containing the care-of address for temporary use while registration is completed. The nSMM 610 will generate and transmit an AAA Registration and Authentication Request message (AAA Reg Req) 725 to

the FAAA 621. The FAAA 621 receives the AAA Reg Req 725 and forwards an AAA Registration and Authentication Response message (AAA Reg Res) 730 to the HAAA 620 based on the network access identifier extension (NAI) contained in the AAA Reg Req 725.

When the HAAA 620 receives an AAA Reg Req 730, it authenticates the identification and authorization of the MN 664. If the MN 664 authentication and authorization are affirmative, the HAAA 620 forwards the AAA Reg Req 735 to the HMM 640. The HMM 640 will process the AAA Reg Req 735. If the MN 664 lacks a home IP address, the MN 664 will have requested allocation of one. If requested, the HMM 640 will allocate a home IP address for the MN 664. If the home network 699 is provisioned with multiple home agents for load distribution, the HMM 640 may designate HAn 625 to serve the MN 664. The HMM 640 will then construct an AAA Registration and Authentication Response message (AAA Reg Res) 740 with this information on the designated HAn 625 and the authentication data and transmit an AAA Reg Res 740 to the HAAA 620.

The HAAA 620 will transmit an AAA Reg Res message 745 to the FAAA 621, which will contain a care-of address for use by the MN 664 allocated by the DHCPv6 sever 631 and any home IP address allocated by the HMM 640 as well as affirmative confirmation of AAA. The FAAA 621 will transmit an AAA Reg Res 750 to nSMM 610, and the nSMM 610 will generate and transmit a Reg Res 755 to the MN 664 containing the allocated care-of address and any home IP

address. Once the MN 664 receives the Reg Res 755, it sends a BU 760 to the HMM 640 or any assigned HAm 625. The HMM 640 or HAm 625 will then respond with a BA 765, completing the registration.

Figure 9 depicts the situation where a MN 864 has moved and does a hand-off from one foreign network 899 to a new foreign network 900. Figure 9 shows three networks 898, 899, and 900. The old foreign network 899 has an old FAAA server (oFAAA) 845, an old SMM (oSMM) 810, and a foreign agent (FA) 830. The new foreign network 900 has a new FAAA server (nFAAA) 850, a DHCPv6 server 860, and a new SMM (nSMM) 815. The home network 898 has a home AAA server (HAAA) 840, a home mobility manager (HMM) 820, and a home agent (HA) 825.

On the old foreign network 899, the FA 830 is connected to the oSMM 810 by communication link 831. The oSMM 810 is connected to a central buss line 877 by communication link 811, and the oFAAA 845 is connected to the central buss line 877 by communication link 812. Although a wireless connection is shown linking MN 864 to nSMM 815, alternatively the link connecting MN 864 to nSMM 815 could be a wired connection.

On the new foreign network 900, the MN 864 is connected to transceiver 860 by wireless link 866. The transceiver 860 is connected to the nSMM 815 by communication link 859, and the nSMM 815 is connected to central buss line 871 by communication link 817. The central buss line 871 is connected to nFAAA

850 by communication link 821 and to DHCPv6 server 860 by communication link 819. On the home network 898, the HAAA 840 is coupled to a central buss line 873 by communication link 841. The HMM 820 is connected to the central buss line 873 by communication link 823, and the HA 825 is connected to the HMM 820 by communication link 827.

The three networks, 898, 899, and 900 are also connected to the Internet 870. The old foreign network 899 is connected to the Internet 870 by communication link 881, which is coupled to the central buss line 877. The new foreign network 900 is connected to the Internet 870 by communication link 883, which is coupled to the central buss line 871. The home network 898 is connected to the Internet 870 by communication link 882, which is coupled to central buss line 873. MN 864' is shown moving from a location connected to oSMM 810 to a new location connected to nSMM 815.

Figure 10 depicts the message flow for the embodiment where the MN 864 moves unexpectedly from one foreign network 899 to another foreign network 900 and performs a hand-off. This embodiment is referred to as a Reactive Inter-Domain Hand-off. The MN 864 sends a Reg Req 905 to the nSMM 815 to obtain a co-located, globally routable address. The format of the IP header for the Reg Req 905 is the same as shown in Fig. 1A. The nSMM 815 validates the identity of the MN 864, and then transmits a DHCPv6 Req 910 to the DHCPv6 server 860. The DHCPv6 server 860 allocates a new address to use

as a care-of address and sends a DHCPv6 Res 915 back to the nSMM 815. At this point, an optional IP Offer message 920 containing the care-of address for temporary use until the registration process is complete may be sent to the MN 864 by nSMM 815. The nSMM 815 sends an AAA System Hand-off and Context Request message (AAA SHC Req) 925 to oSMM 810 to allocate an agent, FA 830, in the old foreign network 899.

The oSMM 810 will allocate FA 830 to forward information packets to the MN 860 by generating and transmitting a BU 930 to the FA 830. This will cause the FA 830 to forward information packets from the old care-of address to the new care-of address. This binding will last until registration is complete and then expire. The FA 830 will respond with a BA 935 back to the oSMM 810 acknowledging the BU 930.

The oSMM 810 will verify the AAA SHC Req 925 by sending an AAA System Hand-off and Context Response message (AAA SHC Res) 940 to the nSMM 815. The nSMM 815 will verify the message and allocate a co-located care-of address for the MN 864, which it will transmit to the MN 864. The nSMM 815 will generate and transmit an AAA Registration and Authorization Request message (AAA Reg Req) 945 to the nFAAA 850, which forwards the message to the HAAA 840 based on the network access identifier (NAI) extension in the MN 864 Reg Req 905.

When the HAAA 840 receives the AAA Reg Req 945, it authenticates the identification and authorization of the MN 864. If the MN 864 authentication and authorization are affirmative, the HAAA 840 forwards an AAA Reg Req 950 to the HMM 820. The HMM 820 will process the AAA Reg Req 950. If the MN 864 lacks a home IP address, the MN 664 will have requested allocation of one. If requested, the HMM 820 will allocate a home IP address for the MN 864. If the home network 699 supports more than one HA 825 for load distribution and balancing, the HMM 820 may designate a HA 825 to serve the MN 864.

The HMM 820 will construct an AAA Registration and Authorization Response (AAA Reg Res) 955 with this information on the designated HA 825 and the authentication data and transmit the message back through the HAAA 840 and nFAAA 850 to nSMM 815. The HAAA 840 will forward the AAA Reg Res 960 to nSMM 815. The nSMM 815 will generate and transmit a Reg Res 965 to the MN 864 containing the allocated, co-located care-of address, any home address for the MN 864, and confirmation of authorization and authentication. After receiving the Reg Res 965, the MN 864 completes the registration by sending a BU 970 to the HMM 820 or any assigned HA 825, which will acknowledge with a BA 975.

Figure 11 shows an embodiment where MN 1064 is aware of moving prior to moving from old foreign network 999 to new foreign network 1000 and requests a hand-off prior to moving. Figure 11 shows three networks 998, 999,

1000. The old foreign network 999 includes an oFAAA 1045, an oSMM 1010, and a FA 1030. The new foreign network 1000 has an nFAAA 1050, a DHCPv6 server 1060, and an nSMM 1015. The home network 998 has a HAAA 1040, a HMM 1020, and a HA 1025.

On the old foreign network 999, the FA 1030 is connected to the oSMM 1010 by communication link 1031. The oSMM 1010 is connected to a central buss line 1077 by communication link 1011, and the oFAAA 1045 is connected to the central line buss 1077 by communication link 1012. The MN 1064 is connected to a transceiver 1060 by wireless link 1066, and the transceiver 1060 is connected to the oSMM 1010 by communication link 1059. Although a wireless link 1066 is shown, alternatively, MN 1064 could be connected to the oSMM 1010 by a wired communication link.

On the new foreign network 1000, the nSMM 1015 is connected to a central line buss 1071 by communication link 1017. The DHCPv6 1060 is connected to the central buss line by communication link 1019, and an nFAAA 1050 is connected to the central buss line 1071 by communication link 1021.

On the home network 998, the HAAA 1040 is coupled to a central buss line 1073 by communication link 1041. The HMM 1020 is connected to the central buss line 1073 by communication link 1023, and the HA 1025 is connected to the HMM 1020 by communication link 1027.

The three networks 998, 999, and 1000 are also connected to the Internet 1070. The old foreign network 999 is connected to the Internet 1070 by communication link 1081, which is coupled to the central buss line 1077. The new foreign network 1000 is connected to the Internet 1070 by communication link 1083, which is coupled to the central buss line 1071. The home network 998 is connected to the Internet 1070 by communication link 1082, which is coupled to the central buss line 1073. The MN 1064' connected to nSMM 1015 is the location the MN 1064 is moving to.

Figure 12 shows the message flow for the embodiment where the MN 1064 lacks Layer-2 connectivity to a new foreign network 1000 it is aware it is moving to and performs a hand-off to move to the new foreign network 1000. This embodiment is referred to as a Proactive Inter-Domain Hand-off. The MN 1064 sends a System Hand-off Request message (SHO Req) 1105 to the oSMM 1010 when it detects that it is moving to new foreign network 1000. The format of the IP header for SHO Req 1105 is the same as shown in Fig. 1A. The oSMM 1010 sends an AAA Hand-off and Context Transfer Request message (AAA HCT Req) 1110 to the future nSMM 1015 via the oFAAA 1045 on the old foreign network 999 and nFAAA 1050. The nSMM 1015 transmits a DHCPv6 Req 1115 to the DHCPv6 1060 to obtain a new address to use as a care-of address. The DHCPv6 1060 allocates an IP address and sends a DHCPv6 Res 1120 back to the nSMM 1015 with a care-of address. The nSMM 1015 then generates and

transmits an AAA Hand-off and Context Transfer Response message (AAA HCT Res) 1125 to the oSMM 1010 again via the nFAAA 1050 and oFAAA 1045 with the care-of address.

The oSMM 1010 allocates a FA 1030 to bi-cast data destined for the MN 1064 to both the old and new care-of address by transmitting a BU 1130, and the FA 1030 will transmit a BA 1135 back to the oSMM 1010. The oSMM 1010 will then send a System Hand-off Response message (SHO Res) 1140 back to the MN 1064 to confirm executing the hand-off and transmitting the co-located care-of address to the MN 1064.

When the MN 1064 receives the SHO Res 1140 from the oSMM 1010 and establishes Layer 2 connectivity to the new foreign network 1000, it will transmit a Reg Req 1145 to the nSMM 1015. The nSMM 1015 will then construct and transmit an AAA Registration Request message (AAA Reg Req) 1150 to the HAAA 1040 via nFAAA 1050. The HAAA 1040 will authenticate the MN 1064. If the MN 1064 authentication and authorization is affirmative, the request is forwarded to the HMM 1020 for further processing by an AAA Reg Req 1155.

The HMM 1020 updates the user state information, allocates HA 1025 to serve MN 1064, and constructs an AAA Registration Response message (AAA Reg Res) 1160 to transmit to the HAAA 1040 conveying the data. When the HAAA 1040 receives the Reg Res 1160, it in turn generates and transmits an AAA Reg Res 1165 to the nSMM 1015 via nFAAA 1050. The nSMM 1015 then

sends a Reg Res 1170 to the MN 1064 conveying the information. Once the MN 1064 receives a Reg Res 1170, it proceeds to complete registration by sending a BU 1175 containing the care-of address to the HA 1025, which acknowledges with a BA 1180.

As a further alternative embodiment in each of these embodiments the mobility managers (SMM 10, HMM 40, nSMM 210, oSMM 212, HMM 240, nSMM 410, oSMM 412, HMM 440, nSMM 610, HMM 640, oSMM 810, nSMM 815, HMM 820, oSMM 1010, nSMM 1015, and HMM 1020) may maintain a pool of addresses to allocate as care-of addresses to mobile nodes. If there is a pool of addresses to allocate, then the DHCPv6 Request messages (110, 310, 615, 710, 910 and 1115) and the DHCPv6 Response message (115, 315, 620, 715, 915, and 1120) are eliminated. In place of these messages (110, 115, 310, 315, 615, 620, 710, 715, 910, 915, 1115, and 1120) the SMM 10, nSMM 210, nSMM 410, nSMM 610, nSMM 815, and nSMM 1015 will periodically request a new pool of addresses from the DHCPv6 server to allocate as care-of addresses.

While the invention has been particularly shown and described with respect to preferred embodiments, it will be readily understood that minor changes in the details of the invention may be made without departing from the spirit of the invention. Having described the invention, we claim:

Claims:

1. A method for registration of a mobile node on a packet-based communication network comprising the steps of:

receiving a care-of address for said mobile node, at a home network, under a first circumstance from a server computer on a first network, wherein said care-of address is an expanded address identifying the network address location for said mobile node; and

updating the mobile node's registration address on the home network with said care-of address.

2. The method of registration of a mobile node on a packet-based communication network of Claim 1 further comprising the step of:

requesting said care-of address from a serving mobility manager on the first network.

3. The method for registration of a mobile node on a packet-based communication network of Claim 2 further comprising the step of:

allocating said mobile node care-of address on the first network after said request step.

4. The method for registration of a mobile node on a packet-based communication network of Claim 3 wherein the care-of address is transmitted through the serving mobility manager on the first network to said home network.

5. The method for registration of a mobile node on a packet-based communication network of Claim 3 wherein the care-of address is obtained from a pool of expanded addresses provided to said serving mobility manager on the first network.

6. The method for registration of a mobile node on a packet-based communication network of Claim 2 wherein said first network is a foreign network and said first circumstance is a power-up performed by said mobile node on said foreign network.

7. The method for registration of a mobile node on a packet-based communication network of Claim 2 wherein said first network is a foreign sub-network located on said home network and said first circumstance is a power-up performed by said mobile node on said foreign sub-network.

8. The method for registration of a mobile node on a packet-based communication network of Claim 1 wherein the care-of address is allocated by an AAA server computer on said first network.

9. A method of performing a mobile node hand-off on a packet-based communication network, comprising the steps of:

responding at a second network to a request for said mobile hand-off from a first network, said response including a care-of address, said care-of address having an expanded address capable of identifying the network address location for the mobile node; and

updating the care-of address for the mobile node on the first network.

10. The method of performing a mobile node hand-off on a packet-based communication network of Claim 9 wherein the mobile node receives said care-of address from a serving mobility manager.

11. The method of performing a mobile node hand-off on a packet-based communication network of Claim 9 wherein the first network is a first foreign sub-network on a home network.

12. The method of performing a mobile node hand-off on a packet-based communication network of Claim 10 wherein the second network is a second foreign sub-network on a home network.

13. The method of performing a mobile node hand-off on a packet-based communication network of Claim 9 wherein the first network is a first foreign network.

14. The method of performing a mobile node hand-off on a packet-based communication network of Claim 13 wherein the second network is a second foreign network.

15. The method of performing a mobile node hand-off on a packet-based communication network of Claim 9 further comprising the steps of:

moving the mobile node to said second network after requesting said system hand-off.

16. The method of performing a mobile node hand-off on a packet-based communication network of Claim 9 further comprising the steps of:

moving the mobile node to said second network before requesting said system hand-off.

17. A method of registering a mobile node on a packet-based communication network comprising the steps of:

transmitting a registration request from a first network to a server computer on a second network;

allocating a care-of address from said server computer on said second network, said care-of address having an expanded address for identifying a network address location of said mobile node,

transmitting said care-of address to said first network.

18. The method for registering a mobile node on a packet-based communication network of Claim 17 wherein the mobile node moves to the second network after the transmission of the registration request.

19. The method of registering a mobile node on a packet-based communication network of Claim 18 wherein the mobile node moves to the second network before the transmission of the registration request.

20. The method for registering a mobile node on a packet-based communication network of Claim 17 wherein the care-of address is transmitted through an AAA server computer to said first network.

AN IMPROVED ASSISTED POWER-UP AND HAND-OFF SYSTEM AND METHOD

ABSTRACT

The invention provides for an improved method and system of registration and hand-off procedures for a mobile node in a packet-based communication network. The present invention obtains expanded addresses over past systems. The invention can also use serving mobility managers to obtain a care-of address to route data-packets while on the foreign sub-network. The invention improves efficiency and reduces message overhead during registration and hand-off.

FIG. 1

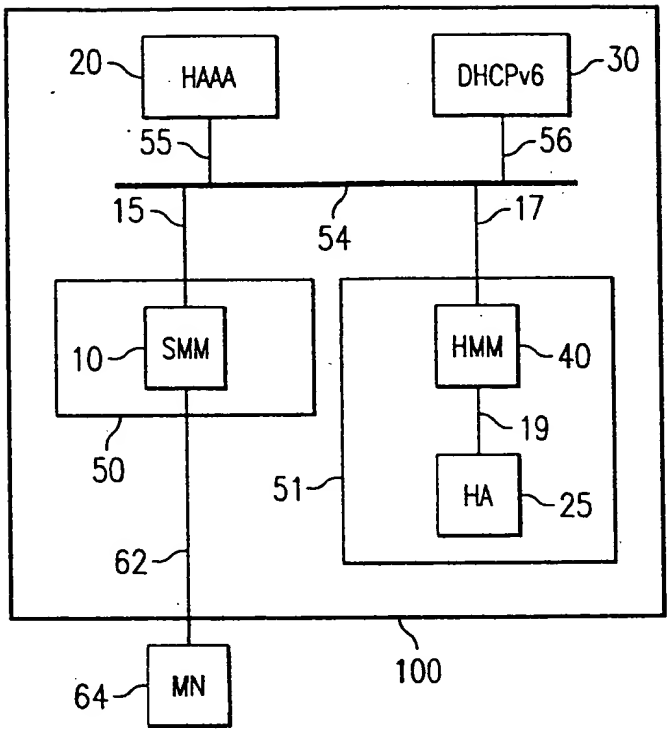

20
HAAA
DHCPv6
30
55
56
15
54
17
10
SMM
HMM
40
19
50
51
HA
25
62
100
64
MN

FIG. 2

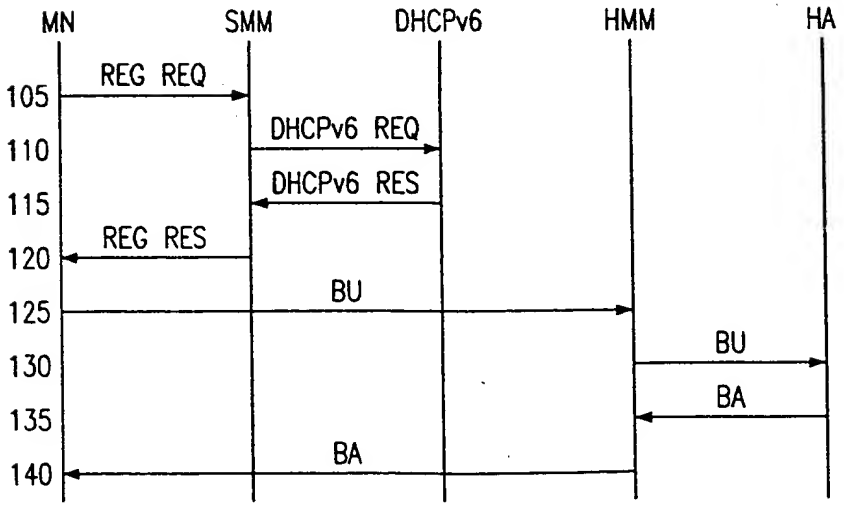

MN
SMM
DHCPv6
HMM
HA
105
REG REQ
110
DHCPv6 REQ
115
DHCPv6 RES
120
REG RES
125
BU
130
BU
135
BA
140
BA

FIG. 1A

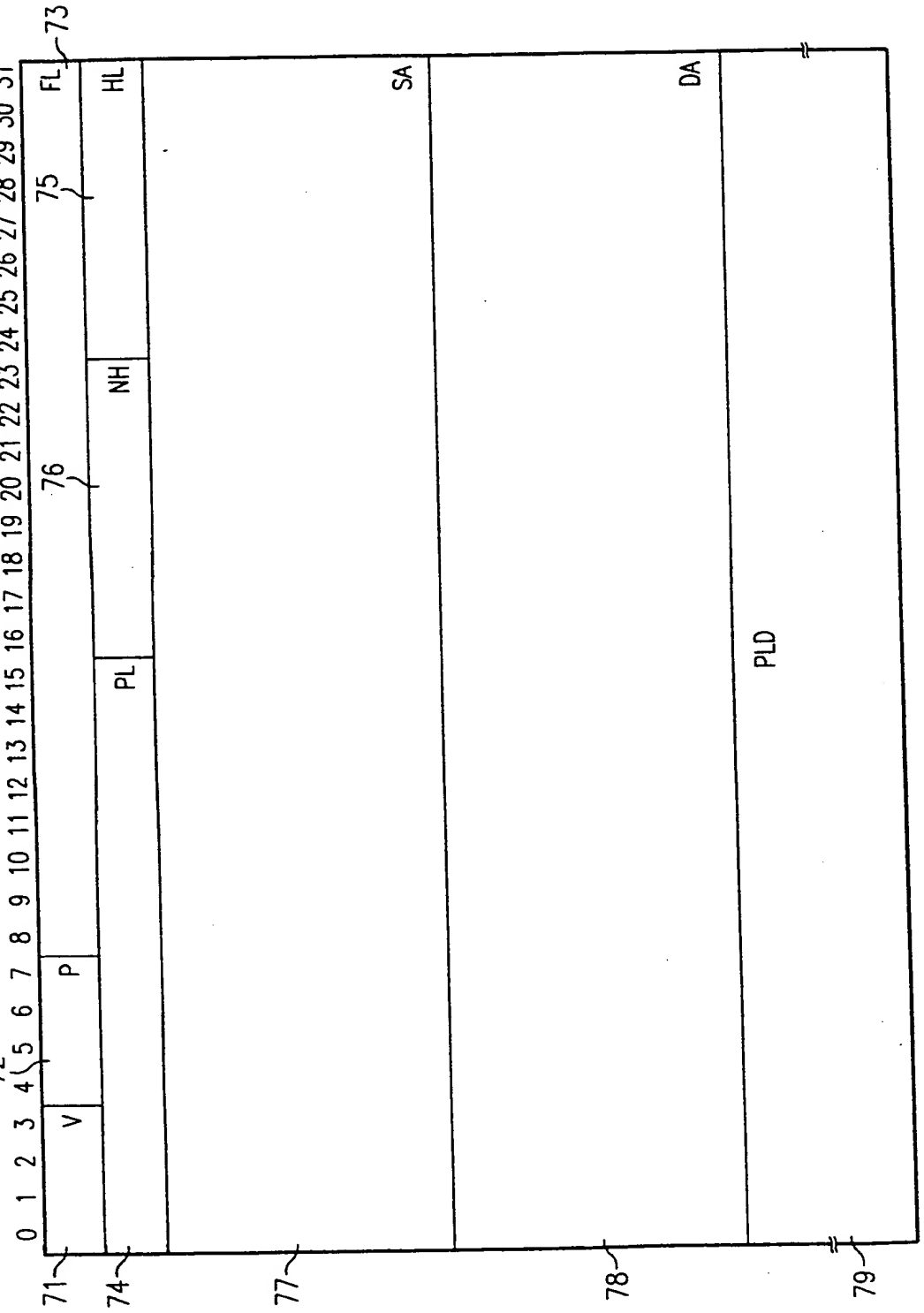

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
72
V
P
PL
NH
HL
FL
73
75
76
SA
DA
PLD
71
74
77
78
79

FIG. 1B

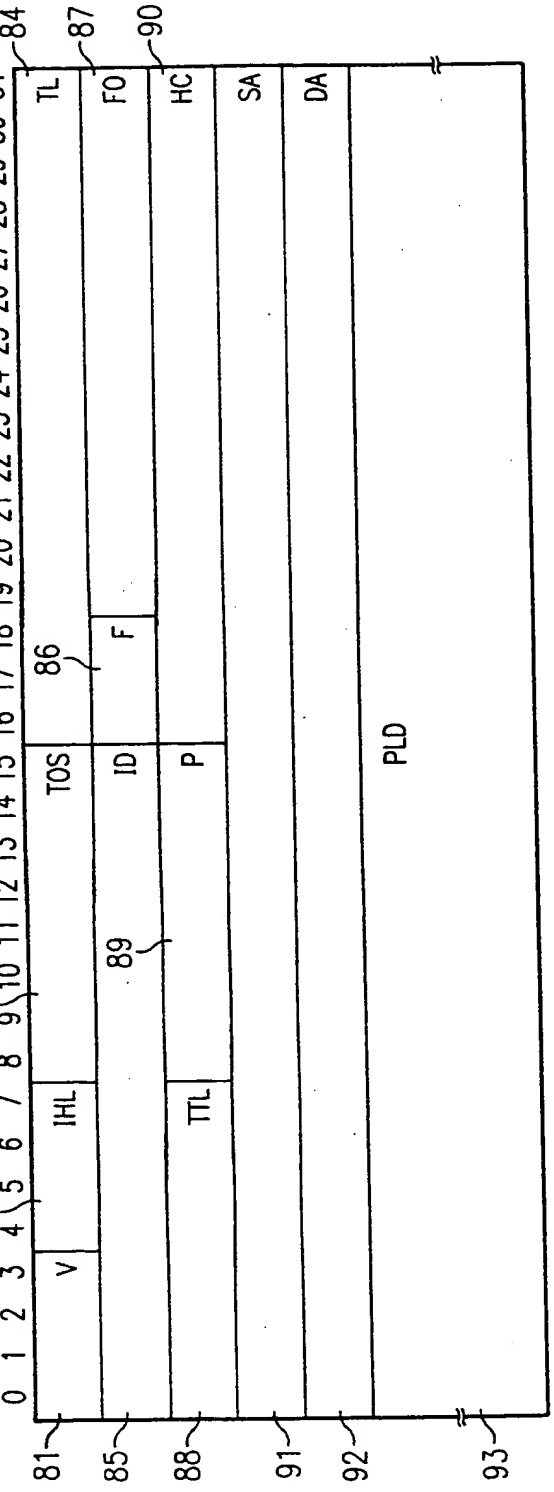

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
82
83
84
87
90
86
89
V
IHL
TOS
TTL
ID
F
P
TL
FO
HC
SA
DA
PLD
81
85
88
91
92
93

FIG. 3

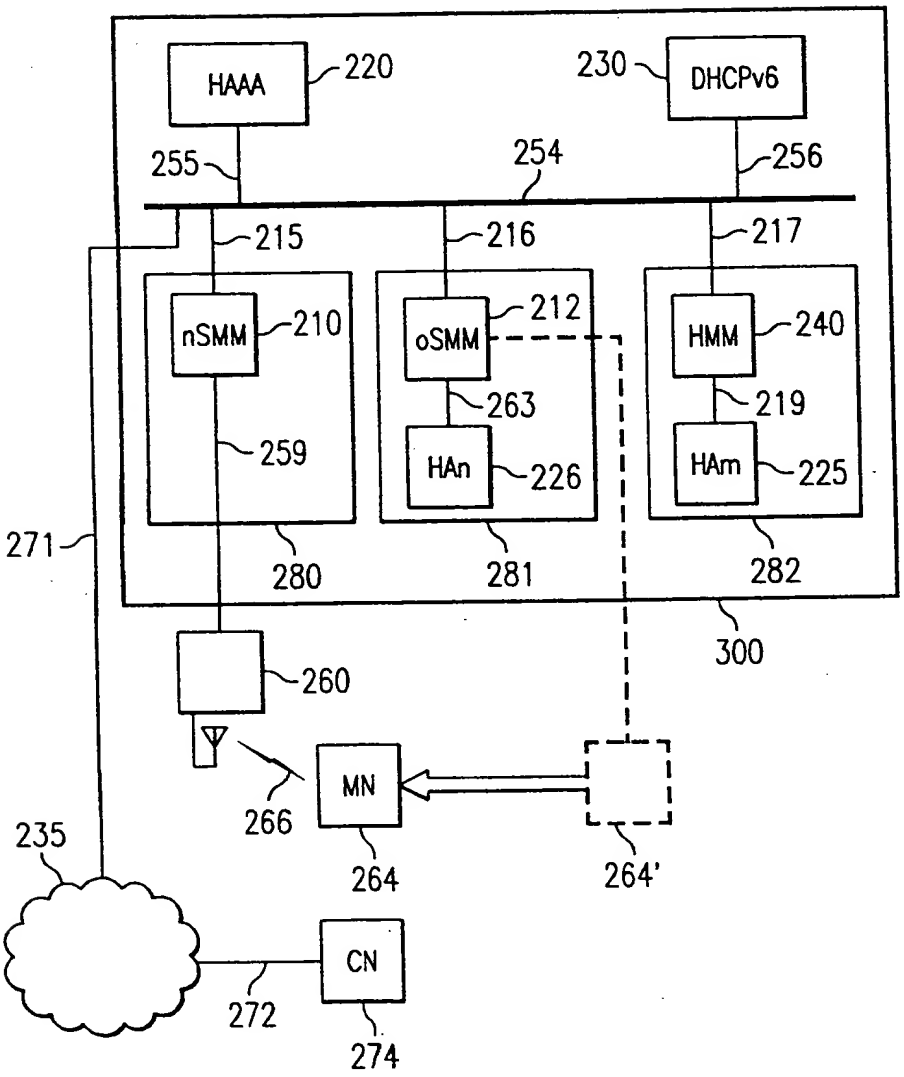

HAAA
220
230
DHCPv6
255
254
256
215
216
217
nSMM
210
oSMM
212
HMM
240
263
219
259
HAn
226
HAm
225
271
280
281
282
300
260
266
MN
264
264'
235
CN
272
274

FIG. 4

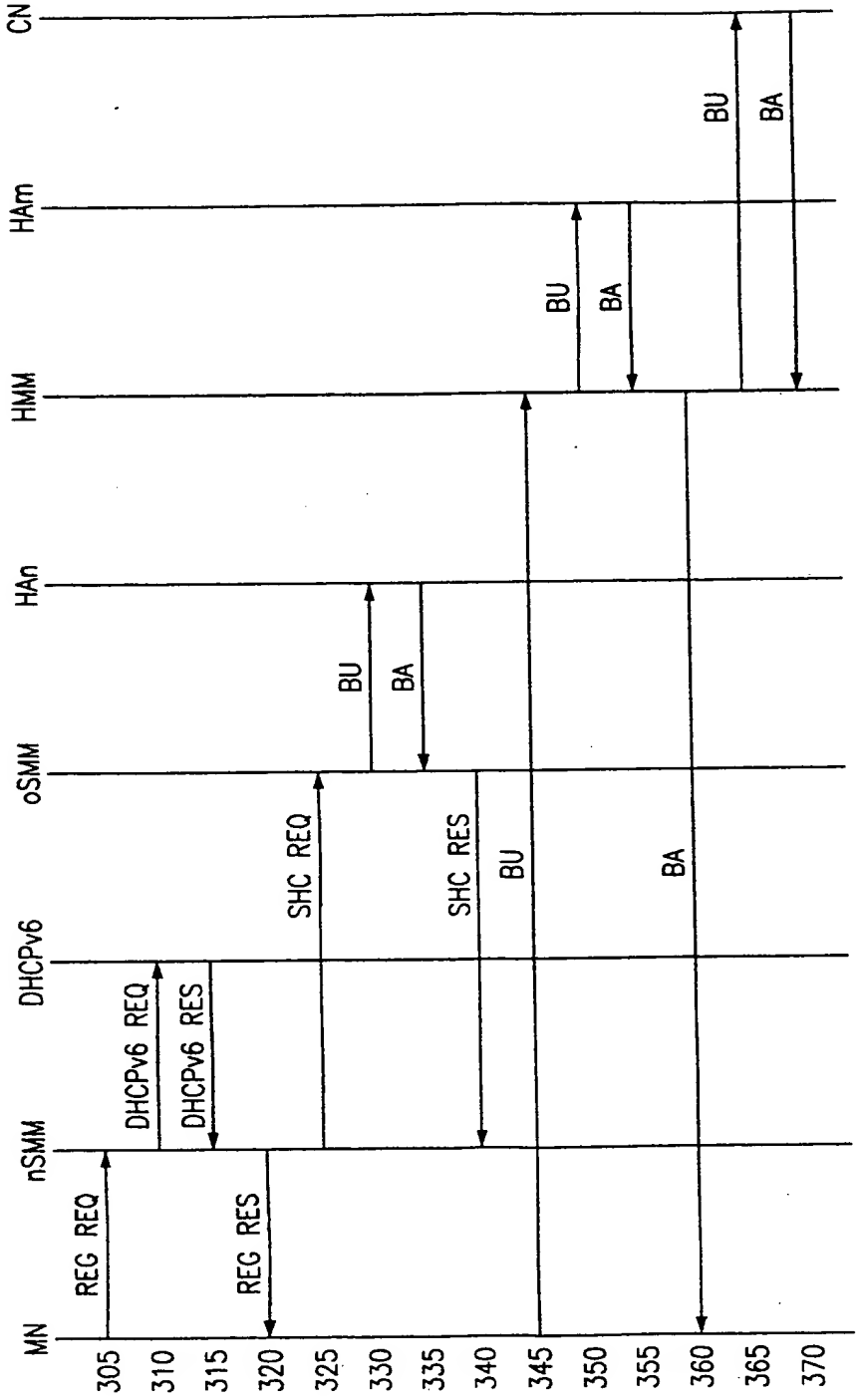

MN
nSMM
DHCPv6
oSMM
HAn
HMM
HAm
CN
REG REQ
REG RES
DHCPv6 REQ
DHCPv6 RES
SHC REQ
SHC RES
BU
BA
305
310
315
320
325
330
335
340
345
350
355
360
365
370

FIG. 5

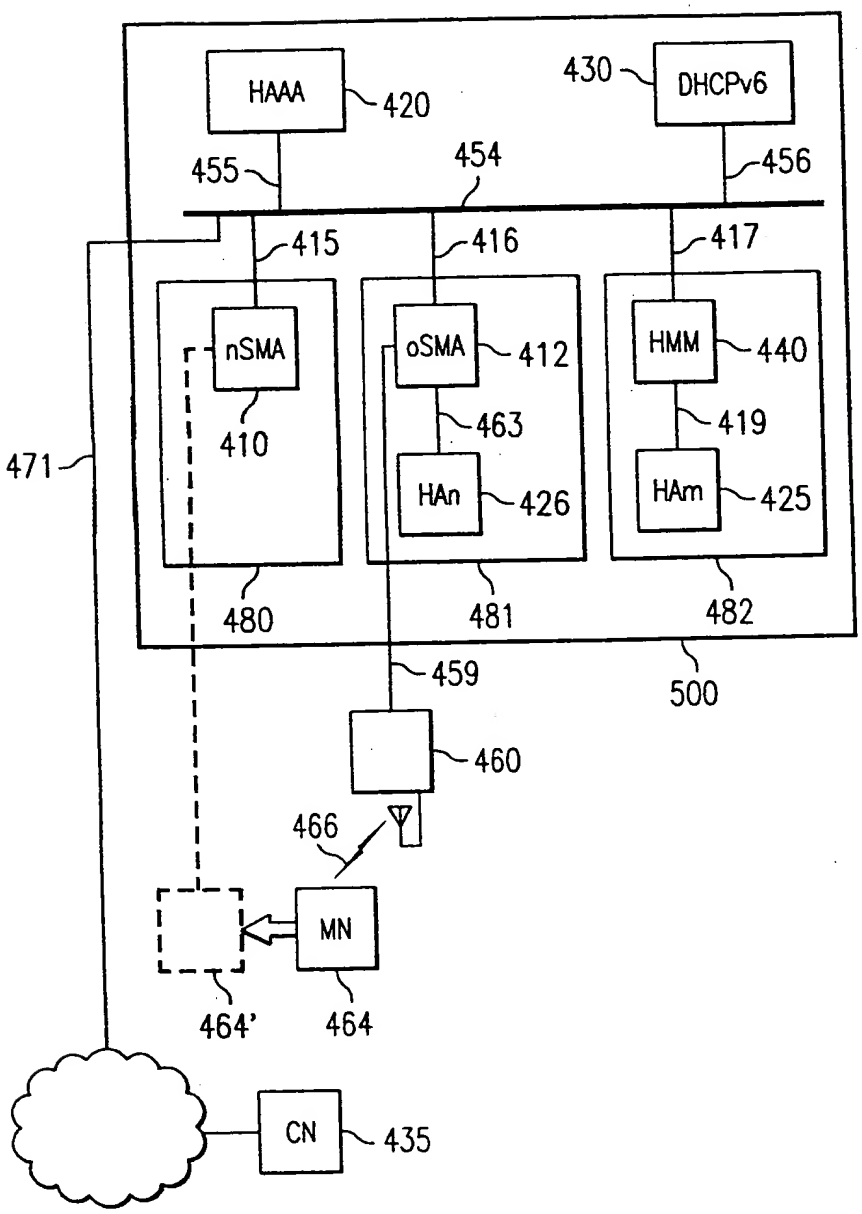
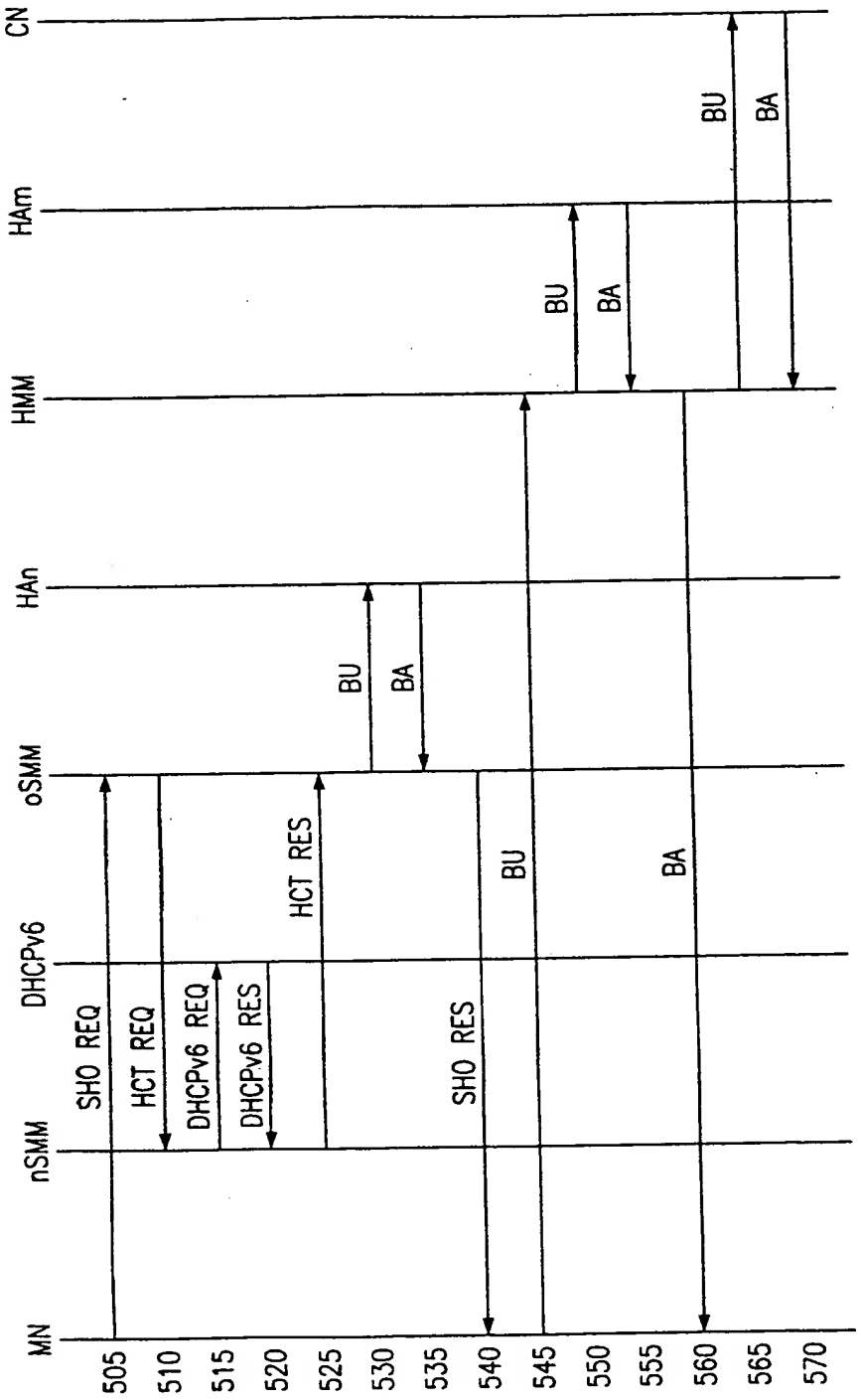

HAAA
420
430
DHCPv6
455
454
456
415
416
417
nSMA
410
oSMA
412
HMM
440
463
419
471
HAn
426
HAm
425
480
481
482
459
500
460
466
MN
464'
464
CN
435

FIG. 6


CN
HAm
HMM
HAn
oSMM
DHCPv6
nSMM
MN
SHO REQ
HCT REQ
DHCPv6 REQ
DHCPv6 RES
HCT RES
SHO RES
BU
BA
505
510
515
520
525
530
535
540
545
550
555
560
565
570

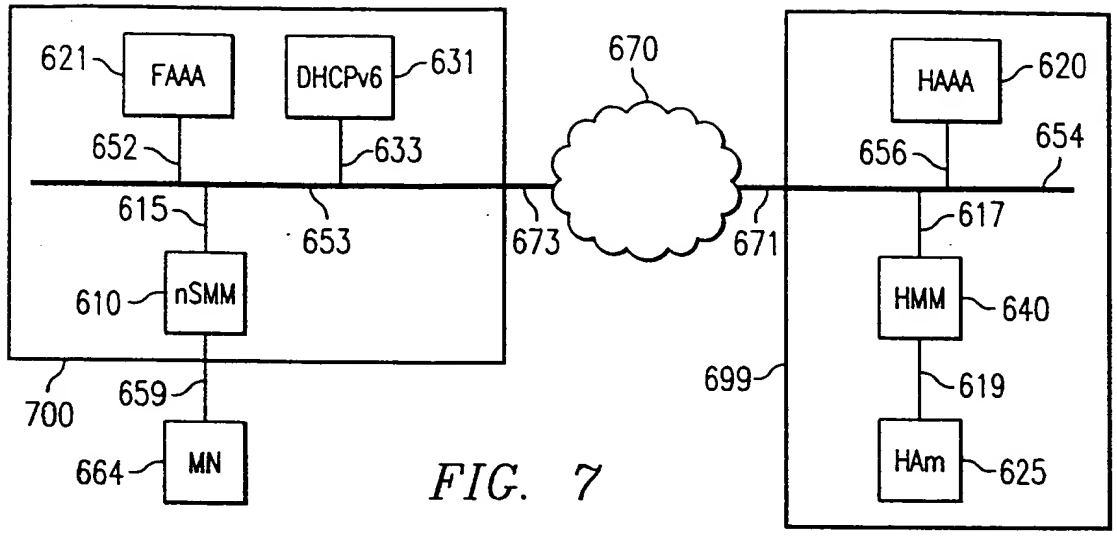

621
FAAA
DHCPv6
631
652
633
615
653
610
nSMM
700
659
664
MN
670
673
671
HAAA
620
656
654
617
HMM
640
699
619
HAm
625

FIG. 7

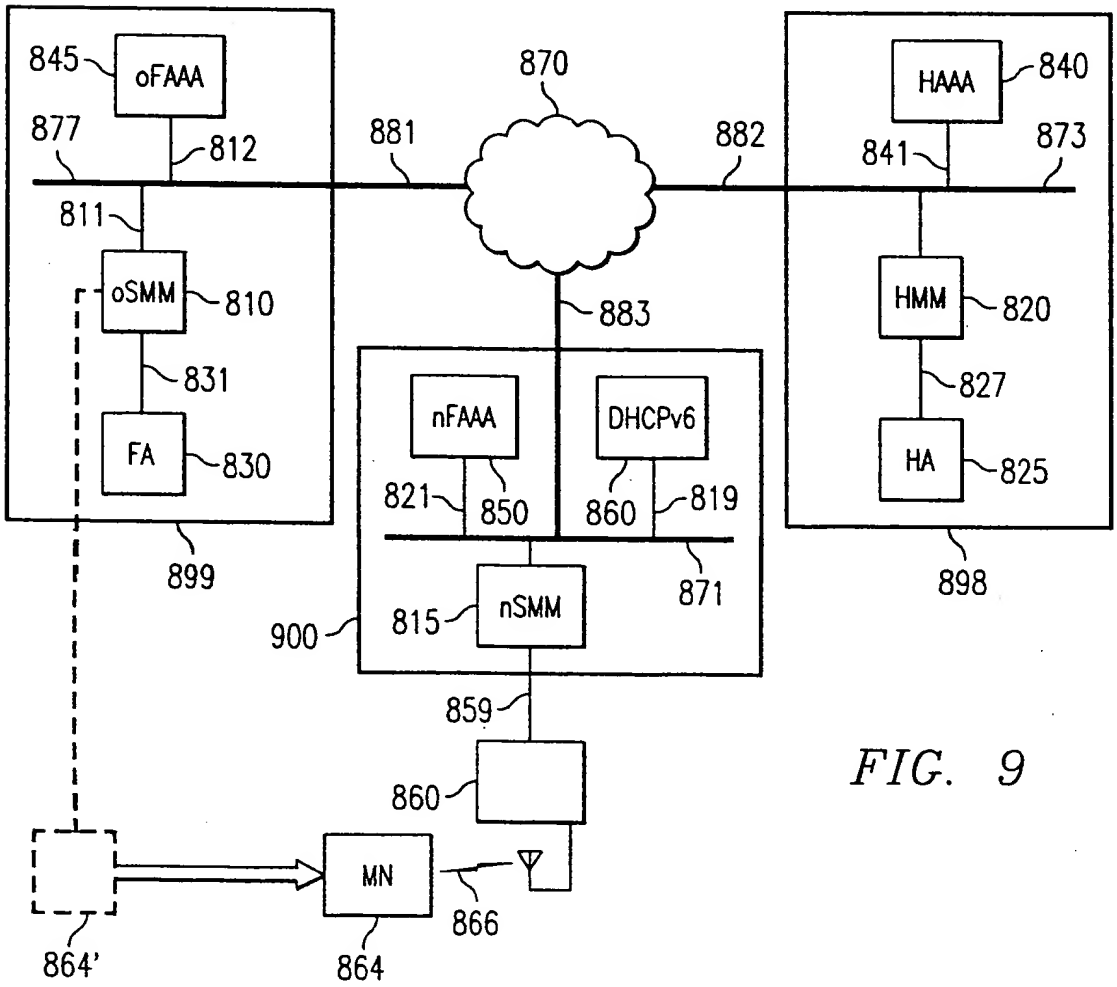

845
oFAAA
877
812
881
870
882
HAAA
840
841
873
811
oSMM
810
883
HMM
820
831
827
FA
830
nFAAA
DHCPv6
HA
825
821
850
860
819
899
871
898
900
815
nSMM
859
860
MN
866
864'
864

FIG. 9

FIG. 8

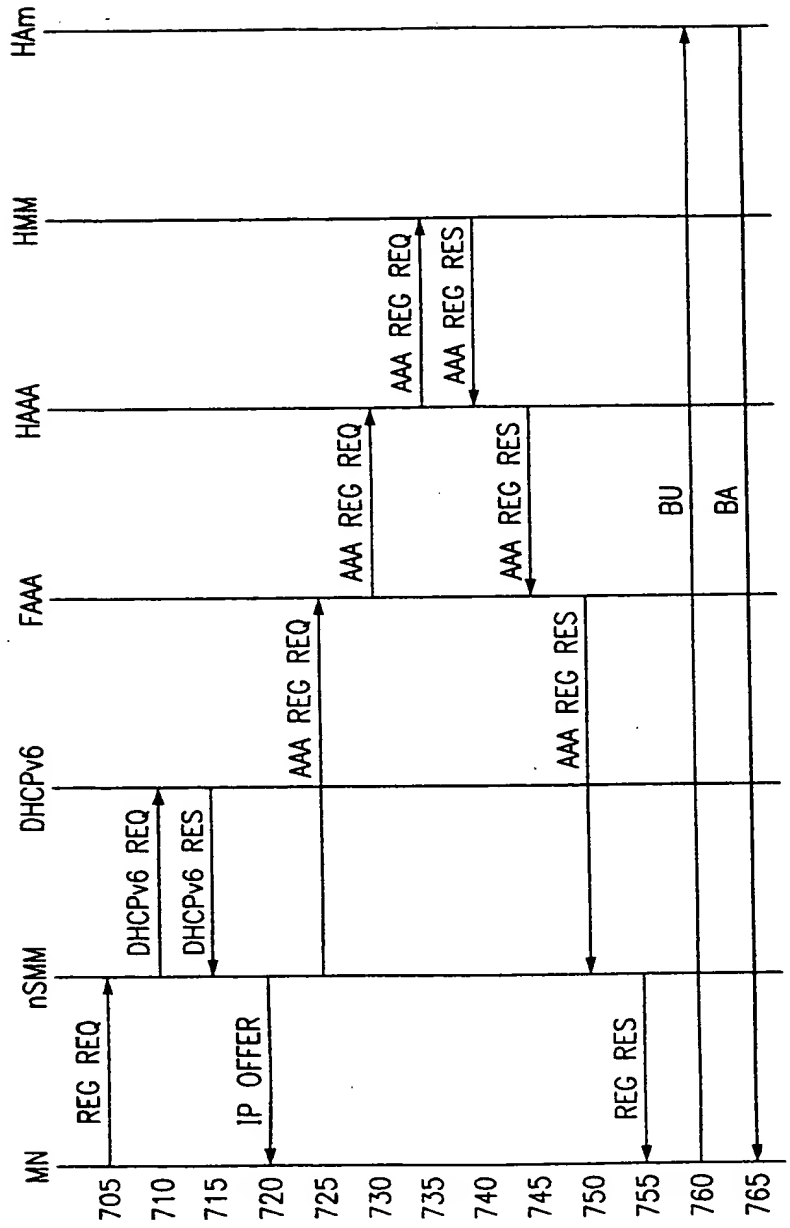
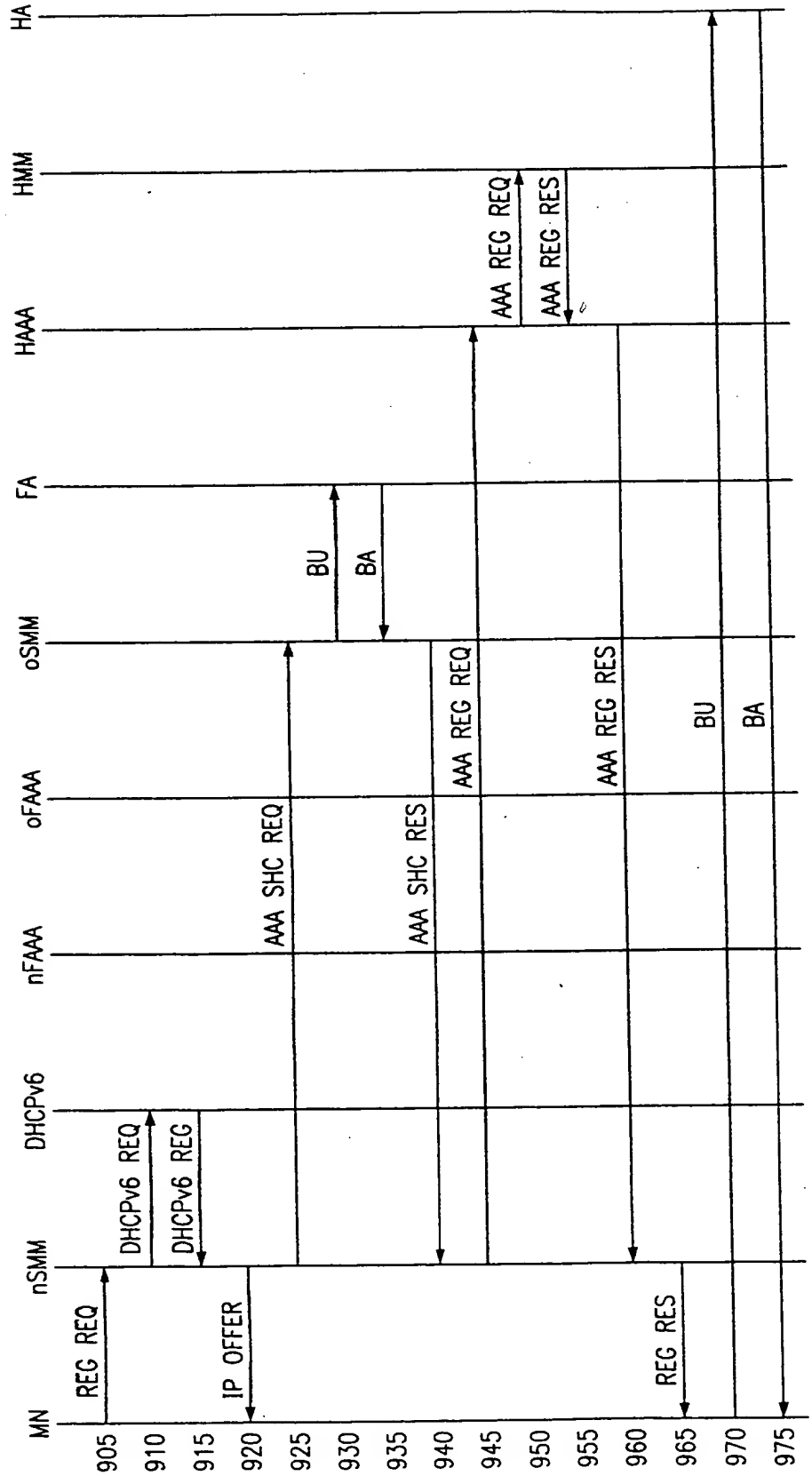

MN
nSMM
DHCPv6
FAAA
HAAA
HMM
HAm
REG REQ
DHCPv6 REQ
DHCPv6 RES
IP OFFER
AAA REG REQ
AAA REG RES
AAA REG REQ
AAA REG RES
AAA REG REQ
AAA REG RES
BU
BA
REG RES
705
710
715
720
725
730
735
740
745
750
755
760
765

FIG. 10


MN
nSMM
DHCPv6
nFAAA
oFAAA
oSMM
FA
HAAA
HMM
HA
REG REQ
DHCPv6 REQ
DHCPv6 REG
IP OFFER
AAA SHC REQ
AAA SHC RES
AAA REG REQ
AAA REG RES
BU
BA
AAA REG REQ
AAA REG RES
BU
BA
REG RES
905
910
915
920
925
930
935
940
945
950
955
960
965
970
975

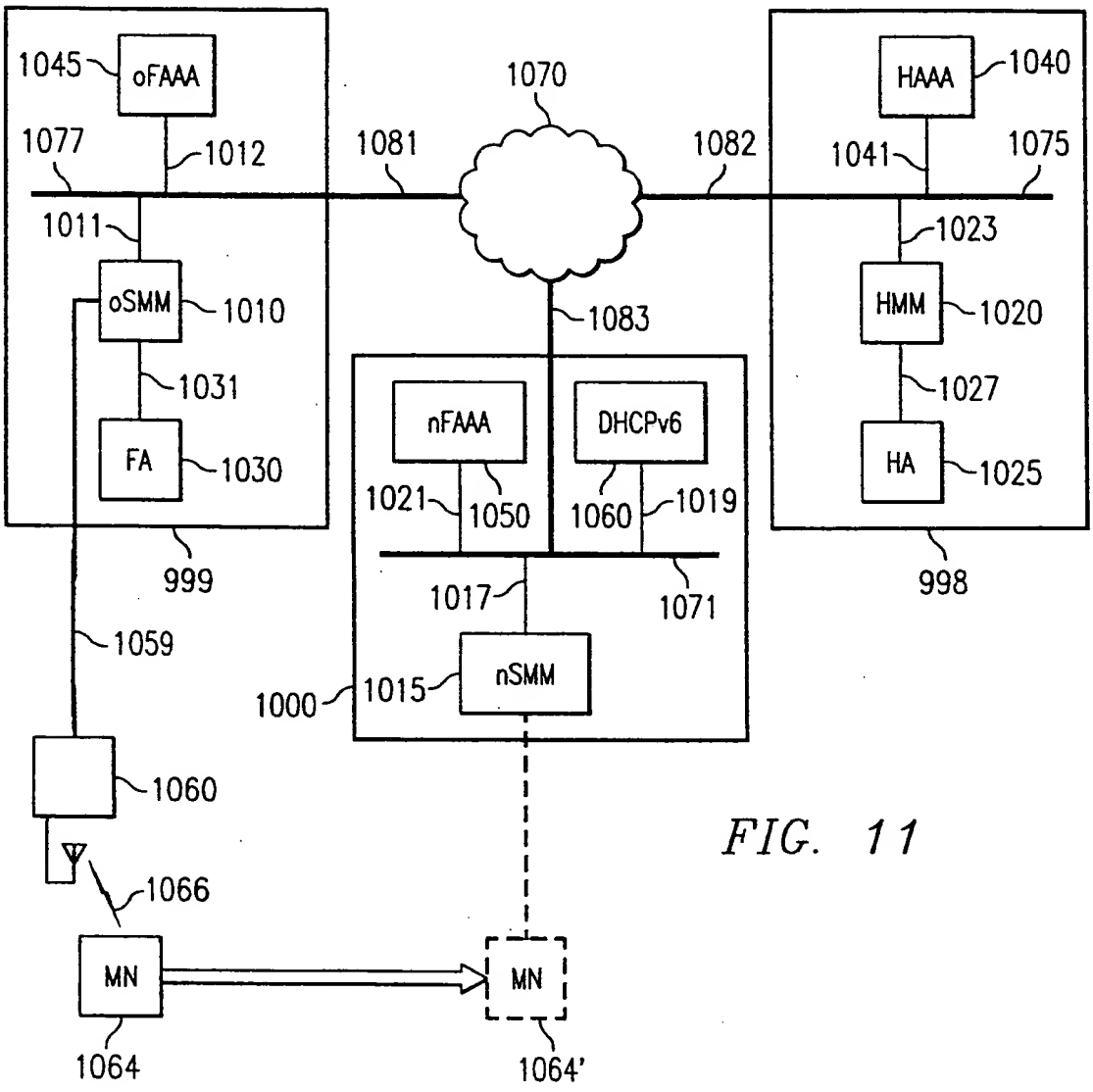
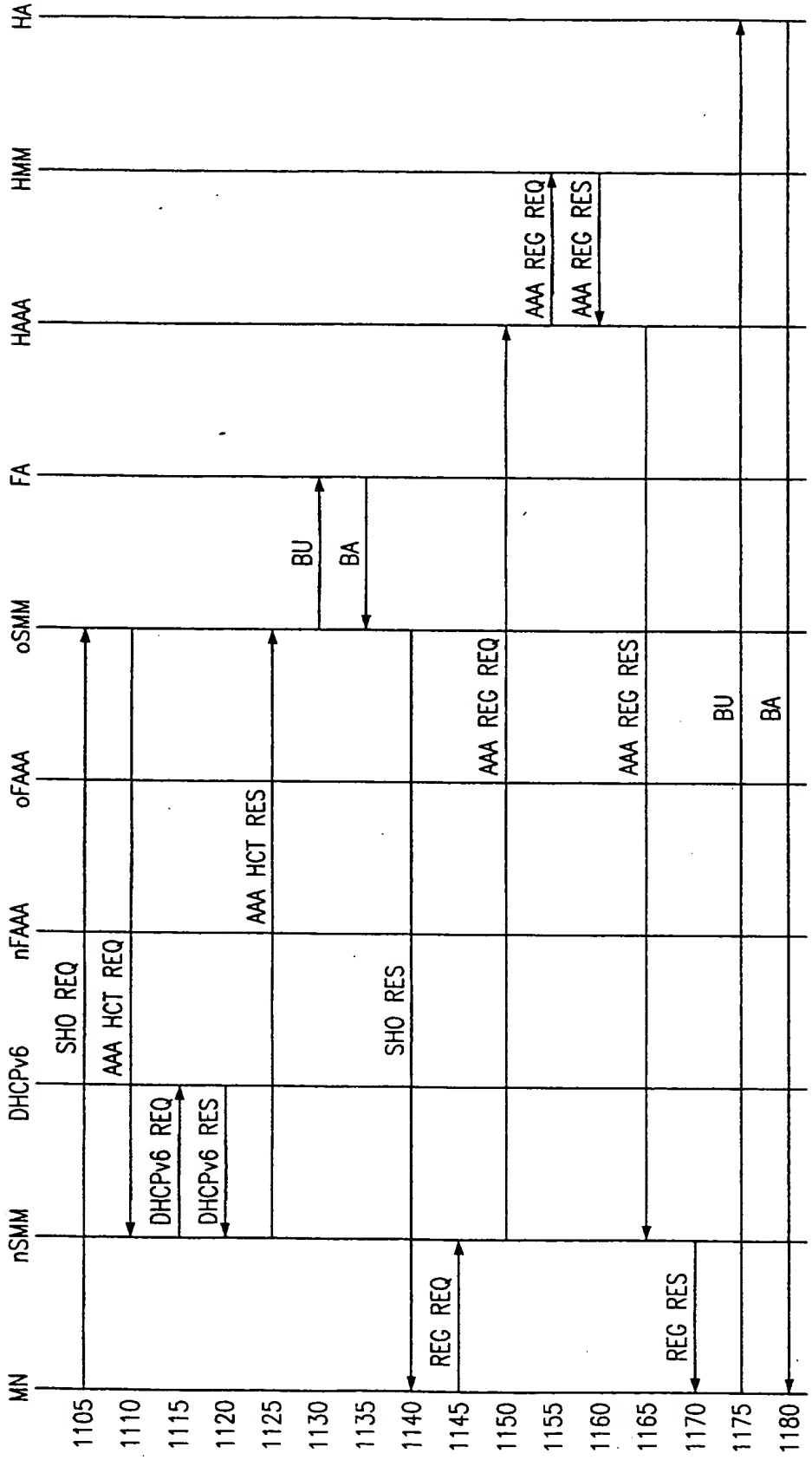

1045
oFAAA
1077
1012
1081
1070
1082
HAAA
1040
1041
1075
1011
1023
oSMM
1010
1083
HMM
1020
1031
1027
FA
1030
nFAAA
DHCPv6
HA
1025
1021
1050
1060
1019
999
998
1017
1071
1059
1000
1015
nSMM
1060
1066
MN
MN
1064
1064'

FIG. 11

FIG. 12


MN
nSMM
DHCPv6
nFAAA
oFAAA
oSMM
FA
HAAA
HMM
HA
SHO REQ
AAA HCT REQ
DHCPv6 REQ
DHCPv6 RES
AAA HCT RES
SHO RES
REG REQ
BU
BA
AAA REG REQ
AAA REG RES
AAA REG REQ
AAA REG RES
BU
BA
1105
1110
1115
1120
1125
1130
1135
1140
1145
1150
1155
1160
1165
1170
1175
1180

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of:	Mohammed Khalil
Serial No.:	09/973,299
Filed:	October 9, 2001
For:	An Improved Assisted Power-Up and Hand-Off System and Method
Group Art Unit:	2135
Examiner:	Nguyen, Phuonochau Ba

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

RESPONSE TO FIRST OFFICE ACTION

In response to the First Office Action mailed October 10, 2005, the Applicants respectfully request reconsideration in light of the following Response.

CERTIFICATE OF MAILING

I hereby certify that this correspondence is, on the date shown below, being deposited with the United States Postal Service with sufficient postage as first class mail, in an envelope addressed to the Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Date: January 5, 2006 Amy Kasper

Amy Kasper

INTRODUCTORY COMMENTS

The Examiner rejected objected to informalities for Claims 2-3 and 15-19, and appropriate amendments are made herein.

Claims 15, 16, and 19 were objected to under U.S.C. § 112 second paragraph for being indefinite. Appropriate amendments are made herein.

The Examiner rejected claims 1-5, 8-14, 17, and 20 under 35 U.S.C. § 102(b) as allegedly anticipated by U.S. Patent 6,892,069 to Flynn (hereafter "Flynn"). Claims 6-7 were rejected under 35 U.S.C. § 103(a) as allegedly unpatentable over Flynn in view of U.S. Patent 6,804,221 to Marget (hereafter "Marget"). Claims 15 and 18 were rejected under 35 U.S.C. § 103(a) as unpatentable over Flynn in view of U.S. Patent 6,681,259 to Lemilainen. Claims 16 and 19 were rejected under 35 U.S.C. § 103(a) as allegedly unpatentable over Flynn in view of U.S. Patent 6,771,609 to Gudat

AMENDMENTS TO THE CLAIMS:

1. (Currently Amended) A method for registration of a mobile node on a packet-based communication network comprising the steps of:

requesting a care-off address for a mobile node by transmitting a request message to a first node on a first network, said first node capable of assigning a unique care-of addresses to each of a plurality of mobile nodes connecting to said first network;

receiving a care-of address for said mobile node[[,]] at a home network[[,]] under a first circumstance from [[a server computer on a]] the first network, wherein said care-of address is an expanded address identifying the network address location for said mobile node on the first network, and said care-of address is included in an information packet that comprises a source address data field containing the expanded address for the source node transmitting data in the information packet, a destination address data field containing the expanded address for the intended destination node ultimately receiving the data, and a payload data field containing the data transmitted from the source node to the destination node;

routing a message acknowledging receiving said care-of address to said first network;

allocating a node on the home network to forward information packets to the mobile node at the care-of address using a binding message transmitted on the first network to said node on the home network; and

updating a plurality of nodes with the mobile node registration address on the home network with said care-of address.

2. (Currently Amended) The method of registration of a mobile node on a packet-based communication network of Claim 1, further comprising the step of[[:]] requesting said care-of address from a serving mobility manager on the first network.

3. (Currently Amended) The method for registration of a mobile node on a packet-based communication network of Claim 2 further comprising the step of[[:]] allocating said mobile node care-of address on the first network after said request step.

4. (Original) The method for registration of a mobile node on a packet-based communication network of Claim 3 wherein the care-of address is transmitted through the serving mobility manager on the first network to said home network.

5. (Original) The method for registration of a mobile node on a packet-based communication network of Claim 3 wherein the care-of address is obtained from a pool of expanded addresses provided to said serving mobility manager on the first network.

6. (Original) The method for registration of a mobile node on a packet-based communication network of Claim 2 wherein said first network is a foreign network and said first circumstance is a power-up performed by said mobile node on said foreign network.

7. (Original) The method for registration of a mobile node on a packet-based communication network of Claim 2 wherein said first network is a foreign sub-network located on said home network and said first circumstance is a power-up performed by said mobile node on said foreign sub-network.

8. (Currently Amended) The method for registration of a mobile node on a packet-based communication network of Claim 1 wherein the care-of address is allocated by [[an AAA]] a server computer on said first network.

9. (Currently Amended) A method of performing a mobile node hand-off on a packet-based communication network, comprising the steps of:

responding at a second network to a request for said mobile hand-off from a first network, said response including allocating a care-of address, said care-of address having an expanded address capable of identifying the network address location for the mobile node on the first network, and said care-of address is included in an information packet that comprises a source address data field containing the expanded address for the source node transmitting data in the information packet, a destination address data field containing the expanded address for the intended destination node ultimately receiving the data, and a payload data field containing the data transmitted from the source node to the destination node;

transmitting said care-of address from a serving mobility manager on said first network to the mobile node, said serving mobility manager functioning to request said care-of address from a first node on the first network capable of allocating a unique care-of address;

allocating a router on the home network to route information packets to said mobile node at the care-of address using a binding message; and

updating the care-of address for the mobile node on a plurality of nodes on the first network and the home network.

10. (Currently Amended) The method of performing a mobile node hand-off on a packet-based communication network of Claim 9 wherein [[the mobile node receives said care-of address from a serving mobility manager]] the first node comprises a computer server.

11. (Original) The method of performing a mobile node hand-off on a packet-based communication network of Claim 9 wherein the first network is a first foreign sub-network on a home network.

12. (Original) The method of performing a mobile node hand-off on a packet-based communication network of Claim 10 wherein the second network is a second foreign sub-network on a home network.

13. (Original) The method of performing a mobile node hand-off on a packet-based communication network of Claim 9 wherein the first network is a first foreign network.

14. (Original) The method of performing a mobile node hand-off on a packet-based communication network of Claim 13 wherein the second network is a second foreign network.

15. (Currently Amended) The method of performing a mobile node hand-off on a packet-based communication network of Claim 9 further comprising the step[[s]] of[[:]]moving the mobile node to said second network after requesting said [[system]] mobile node hand-off.

16. (Currently Amended) The method of performing a mobile node hand-off on a packet-based communication network of Claim 9 further comprising the step[[s]] of[[:]]moving the mobile node to said second network before requesting said [[system]] mobile node hand-off.

17. (Currently Amended) A method of registering a mobile node on a packet-based communication network comprising the steps of:

transmitting a [[registration]] request message from [[a first network]] said mobile node to a [[server computer on a second network]] first router that initiates assigning a care-of address, said mobile node registering on a first network;

receiving a request from said first router at a server computer storing care-of addresses for allocating to registering mobile nodes on the first network;

allocating [[a]] the care-of address from said server computer [[on said second network]], said care-of address having an expanded address for identifying a network address location of said mobile node or other nodes, and said care-of address included in an information packet transmitted over said first network comprising a source address data field containing the expanded address for the source node transmitting data in the information packet, a destination address data field containing the expanded address for the intended destination node ultimately receiving the data, and a payload data field containing the data transmitted from the source node to the destination node;

transmitting said care-of address to a serving mobility manager on a second network, said serving mobility manager allocating a router on the second network to provide routing and other services to the mobile node; and

transmitting said care-of address to said allocated router and responding with a response message to said mobile node indicating registering is complete [[said first network]].

18. (Original) The method for registering a mobile node on a packet-based communication network of Claim 17 wherein the mobile node moves to the second network after the transmission of the [[registration]] request message.

19. (Currently Amended) The method of registering a mobile node on a packet-based communication network of Claim [[18]] 17 wherein the mobile node moves to the second network before the transmission of the [[registration]] request message.

20. (Currently Amended)The method for registering a mobile node on a packet-based communication network of Claim 17 wherein the care-of address is transmitted through an AAA server computer [[to]] on said first network.

REMARKS

I. THE CITED REFERENCE CANNOT SUSTAIN A §102 OR §103 REJECTION OF THE AMENDED CLAIMS

The Examiner rejected claims 1-5, 8-14, 17, and 20 under 35 U.S.C. § 102(b) as allegedly anticipated by U.S. Patent 6,892,069 to Flynn (hereafter "Flynn"). The Examiner also rejected dependent claims 6, 7, 15, 16, 18, and 19 under 35 U.S.C. § 103 in view of the combination of several different prior art references. Claims 6-7 were rejected under 35 U.S.C. § 103(a) as allegedly unpatentable over Flynn in view of U.S. Patent 6,804,221 to Marget (hereafter "Marget"). Claims 15 and 18 were rejected under 35 U.S.C. § 103(a) as unpatentable over Flynn in view of U.S. Patent 6,681,259 to Lemilainen. Claims 16 and 19 were rejected under 35 U.S.C. § 103(a) as allegedly unpatentable over Flynn in view of U.S. Patent 6,771,609 to Gudat

The independent claims 1, 9, and 17 were rejected citing Flynn as the only prior art reference. Under 35 U.S.C. §102, the prior art must disclose each and every claim element for an invention to be anticipated by prior art. *Constant v. Advanced Minor–Devices, Inc.*, 848 F. 2d 1560 (Fed. Cir. 1988). All claim limitations of the invention must also be considered in determining patentability. *Hewlett-Packard Co. v. Bausch & Lomb, Inc.*, 909 F. 2d 1464 (Fed. Cir. 1990). Almost is not enough; the prior art must disclose all the elements. *Connell v. Sears, Roebuck & Co.*, 722 F. 2d 1542 (Fed. Cir. 1983). Accordingly, the absence of any claimed element negates anticipation under §102.

Claims 1, 9, and 17 have been amended to add additional limitations not found in the cited art. The amended independent Claims 1, 9, and 17 include new limitations describing the information packets containing the expanded address, allocating a node on

the home network to forward information packets to the care-of address, and updating a plurality of nodes on the home network with the care-of address. These additional claim elements are not taught, disclosed, or suggested by the cited art.

Flynn fails to teach, suggest, or disclose the invention as claimed in the amended independent claims 1, 9, and 17. Flynn teaches registering a care-of address obtained on a foreign network with its home agent by exchanging Registration Request and Registration Reply messages. The mobile node sends a Registration Request message to the foreign agent, which then forwards it to the home agent. The home agent transmits a Registration Reply message to the foreign agent granting or denying the request, which processes the Reply before forwarding it to the mobile node. *Flynn, col. 2, ln. 9-43.*

Flynn fails to teach, disclose, or suggest the added claim limitations describing the information packet format, the node on the foreign network providing the care-of address, the ability of that node to assign a unique care-of address to a plurality of mobile nodes connecting to the network, allocating a node on the home network to forward information packets to the mobile node at the care-of address with a binding message, or updating a plurality of nodes on the home network with the care-of address. Further, neither mobility managers nor server computers are taught, suggested, or disclosed by Flynn as claimed in the invention.

Flynn is the only cited reference for rejecting the independent claims in a § 102(e) rejection, and Flynn cannot support a § 102(e) rejection of the amended claims because it fails to disclose, teach, or suggest essential claim elements as identified above. It is believed that these amended independent claims are allowable. Because the dependent

claims add further limitations to the allowable independent claims 1, 9, and 17, the Applicants believe the dependent claims are likewise allowable.

II. THE AMENDED CLAIMS CURE THE 35 U.S.C. § 112 REJECTION

Claims 15 and 16 have been amended to provide proper antecedent bases for the claims. Claim 19 has been amended to correctly depend from the base independent Claim 17.

III. CONCLUSION

The amended claims are distinguishable from the teachings of the cited references. The Applicants believe that the argument and amended claims 1, 9, and 17 traverse the Examiner's 35 U.S.C. § 102(e) and § 103(a) rejections. The § 112 rejections are also believed traversed. Independent claims 1, 9, and 17 are allowable because the Flynn reference fails to disclose, teach, or suggest all the claimed limitations of the amended independent claims. Since the dependent claims add further limitations to the allowable independent claims, the Applicants believe the dependent claims are likewise allowable. Accordingly, pending claims 1-20 are believed allowable because the claimed invention is not disclosed, taught, or suggested by the cited references.

It is believed that no additional fees are necessary for this filing. If additional fees are required for filing this response, then the appropriate fees should be deducted from D. Scott Hemingway's Deposit Account No. 501,270.

Respectfully submitted,

Malcolm W. Pipes
Reg. No. 46,995
Attorney for Applicant

Hemingway & Hansen, LLP
460 Preston Common West
8117 Preston Road
Dallas, Texas 75225
(214)292-8301 (voice)
(214)739-5209 (fax)

CLEAN VERSION OF CLAIMS AFTER AMENDMENTS

1. (Amended) A method for registration of a mobile node on a packet-based communication network comprising the steps of:

requesting a care-off address for a mobile node by transmitting a request message to a first node on a first network, said first node capable of assigning a unique care-of addresses to each of a plurality of mobile nodes connecting to said first network;

receiving a care-of address for said mobile node at a home network under a first circumstance from the first network, wherein said care-of address is an expanded address identifying the network address location for said mobile node on the first network, and said care-of address is included in an information packet that comprises a source address data field containing the expanded address for the source node transmitting data in the information packet, a destination address data field containing the expanded address for the intended destination node ultimately receiving the data, and a payload data field containing the data transmitted from the source node to the destination node;

routing a message acknowledging receiving said care-of address to said first network;

allocating a node on the home network to forward information packets to the mobile node at the care-of address using a binding message transmitted on the first network to said node on the home network; and

updating a plurality of nodes with the mobile node registration address on the home network with said care-of address.

2. (Amended) The method of registration of a mobile node on a packet-based communication network of Claim 1, further comprising the step of requesting said care-of address from a serving mobility manager on the first network.

3. (Amended) The method for registration of a mobile node on a packet-based communication network of Claim 2 further comprising the step of allocating said mobile node care-of address on the first network after said request step.

4. (Original) The method for registration of a mobile node on a packet-based communication network of Claim 3 wherein the care-of address is transmitted through the serving mobility manager on the first network to said home network.

5. (Original) The method for registration of a mobile node on a packet-based communication network of Claim 3 wherein the care-of address is obtained from a pool of expanded addresses provided to said serving mobility manager on the first network.

6. (Original) The method for registration of a mobile node on a packet-based communication network of Claim 2 wherein said first network is a foreign

network and said first circumstance is a power-up performed by said mobile node on said foreign network.

7. (Original) The method for registration of a mobile node on a packet-based communication network of Claim 2 wherein said first network is a foreign sub-network located on said home network and said first circumstance is a power-up performed by said mobile node on said foreign sub-network.

8. (Amended) The method for registration of a mobile node on a packet-based communication network of Claim 1 wherein the care-of address is allocated by a server computer on said first network.

9. (Amended) A method of performing a mobile node hand-off on a packet-based communication network, comprising the steps of:

responding at a second network to a request for said mobile hand-off from a first network, said response including allocating a care-of address, said care-of address having an expanded address capable of identifying the network address location for the mobile node on the first network, and said care-of address is included in an information packet that comprises a source address data field containing the expanded address for the source node transmitting data in the information packet, a destination address data field containing the expanded address for the intended destination node ultimately receiving the data, and a

payload data field containing the data transmitted from the source node to the destination node;

transmitting said care-of address from a serving mobility manager on said first network to the mobile node, said serving mobility manager functioning to request said care-of address from a first node on the first network capable of allocating a unique care-of address;

allocating a router on the home network to route information packets to said mobile node at the care-of address using a binding message; and

updating the care-of address for the mobile node on a plurality of nodes on the first network and the home network.

10. (Amended) The method of performing a mobile node hand-off on a packet-based communication network of Claim 9 wherein the first node comprises a computer server.

11. (Original) The method of performing a mobile node hand-off on a packet-based communication network of Claim 9 wherein the first network is a first foreign sub-network on a home network.

12. (Original) The method of performing a mobile node hand-off on a packet-based communication network of Claim 10 wherein the second network is a second foreign sub-network on a home network.

13. (Original) The method of performing a mobile node hand-off on a packet-based communication network of Claim 9 wherein the first network is a first foreign network.

14. (Original) The method of performing a mobile node hand-off on a packet-based communication network of Claim 13 wherein the second network is a second foreign network.

15. (Amended) The method of performing a mobile node hand-off on a packet-based communication network of Claim 9 further comprising the step of moving the mobile node to said second network after requesting said mobile node hand-off.

16. (Amended) The method of performing a mobile node hand-off on a packet-based communication network of Claim 9 further comprising the step of moving the mobile node to said second network before requesting said mobile node hand-off.

17. (Amended) A method of registering a mobile node on a packet-based communication network comprising the steps of:

transmitting a request message from said mobile node to a first router that initiates assigning a care-of address, said mobile node registering on a first network;

receiving a request from said first router at a server computer storing care-of addresses for allocating to registering mobile nodes on the first network;

allocating the care-of address from said server computer, said care-of address having an expanded address for identifying a network address location of said mobile node or other nodes, and said care-of address included in an information packet transmitted over said first network comprising a source address data field containing the expanded address for the source node transmitting data in the information packet, a destination address data field containing the expanded address for the intended destination node ultimately receiving the data, and a payload data field containing the data transmitted from the source node to the destination node;

transmitting said care-of address to a serving mobility manager on a second network, said serving mobility manager allocating a router on the second network to provide routing and other services to the mobile node; and

transmitting said care-of address to said allocated router and responding with a response message to said mobile node indicating registering is complete.

18. (Amended) The method for registering a mobile node on a packet-based communication network of Claim 17 wherein the mobile node moves to the second network after the transmission of the request message.

19. (Amended) The method of registering a mobile node on a packet-based communication network of Claim 17 wherein the mobile node moves to the second network before the transmission of the request message.

20. (Amended) The method for registering a mobile node on a packet-based communication network of Claim 17 wherein the care-of address is transmitted through an AAA server computer on said first network.